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ENERGY CONSTRUCTION, TRANSPORTATION & DISTRIBUTION

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ENERGY OPERATIONS & EQUIPMENT FORECAST

July 15, 1980

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ABOUT THE COVER: Fossils ... the beginning. Oil and gas are fossil fuels that have supplied the bulk of energy used in industrial nations for the past 50 years. They'll play the same role for the next 50 years—until alternate fuels are on stream to replace them. Technology must be continually adapted to new methods of finding and developing oil and gas.

1 Overview of Oil/Gas Operations, Supply/Demand and Technical Advances
Energy Publications staff examines current and future trends in rig use, drilling/production technology, pipelining projects, U.S. gas supply and international oil/gas operations.
Boom Time for U.S. Drillers
by Rich McNally, Associate Editor, PETROLEUM ENGINEER INTERNATIONAL
Production Technology Is Never Static
by W.B. Bleakley, Editor, PETROLEUM ENGINEER INTERNATIONAL
Record Year Seen for Cross-Country Pipelines
by Dean Hale, Editor, PIPELINE & GAS JOURNAL
Gas Distribution Faces Expanding Future
by Norman S. George, Managing Editor, PIPELINE & GAS JOURNAL
World Prepares for Record Oil/Gas Development
by Gregory Martin, Editor, ENERGY NEWS/ENERGY WEEK

Drilling/Production
New equipment, supplies and services in this section are a boon to drilling/producing/field processing operations in all kinds of climates and situations.

72 Cross-Country Pipelining/Gas Distribution
These products come in handy in pipeline construction/maintenance, SNG and LNG processing, gas distribution, leak detection, corrosion control, and measurement.

96 Multiple-Use Tools
New equipment and services in this section improve operations in more than one major division of oil/gas activity.

Front and Back — Inquiry Cards
Prepaid cards in front and back of this issue enable you to get information quickly on any equipment, supplies or services mentioned. Circle the number of the ad or item on one of the cards and mail it. Our computer center forwards your inquiry to the appropriate company.

Send me further details on items corresponding to code numbers circled below:

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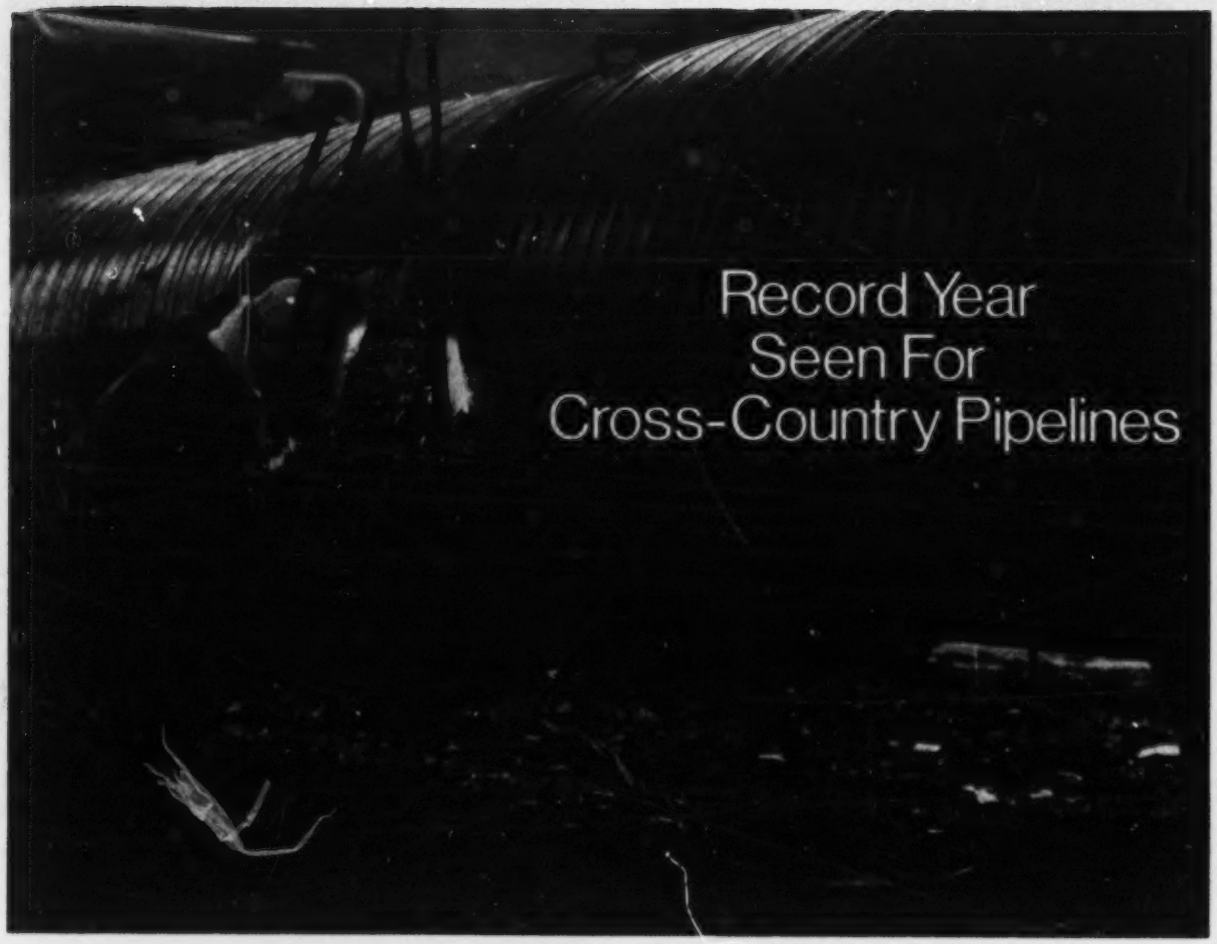

Record Year Seen For Cross-Country Pipelines

by Dean Hale, *Editor, Pipeline & Gas Journal*

With some 125,200 miles of oil and gas pipelines planned or under construction, the world pipeline business is expected to make 1980 another record year. Over $11.27 billion will be spent during the year to install more than 23,000 miles of crude oil, refined products, natural gas liquids, natural gas, and slurry pipelines. That figure includes 8,868 miles of cross-country pipelines in the U.S., at a cost of $3.12 billion, and 14,205 miles outside the U.S. at a cost of $8.15 billion.

No substantial decline in the demand for pipelines to move hydrocarbon energy is foreseen for the next decade, simply because the global demand for energy and for pipeline transportation will continue to increase.

The number of pipeline "super projects" planned or underway is also growing. Among the major projects being built are the Petroline east-to-west 48-in. line stretching 787 miles across Saudi Arabia for Petromin, and the companion and parallel 747-mile, 24- and 30-in. natural gas liquids line for Aramco. Progress on both lines is excellent — the pipelines are on or ahead of schedule and work has begun on the pumping station facilities and terminals.

Work is also getting underway this summer on the 746 miles of 4- thru 48-in. for the big Zadco gathering and delivery system offshore Abu Dhabi. Thailand's 266-mile 34-in. offshore gas line, plus 113 miles of onshore 28-in. pipeline to Bangkok, is to get underway by September 1. In Australia, engineering work is getting underway for initial design on the Dampier to Perth 34- to 36-in. gas line that will deliver gas from the North West Shelf to markets 860 miles away.

Moving slowly toward actuality, the Alaska Highway Gas Pipeline Project, which hopefully will deliver gas from Alaska's Prudhoe Bay to the "lower 48," has life in its branches. Work is expected to get underway in 1980 on the 160.5 miles of 36-in. for the western leg, first phase of a 911-mile, 36-in. loop of the existing Pacific Gas Transmission/Pacific Gas & Electric Alberta-to-California line. The eastern leg, 809 miles of 42-in. to be built by Northern Border Pipeline, is also planned for initial construction in 1980. And in Alberta, Foothills Pipeline and Alberta Natural Gas hopefully will get work underway on pre-build sections that will permit Alberta natural gas to flow through to U.S. markets until the gas from Prudhoe Bay begins flowing southward. Much of the final route selection for the 743-mile Northwest Alaska Pipeline section is now complete — and only about 29[illegible] miles of the 48-in. will parallel the trans-Alaska oil pipeline; the remainder will go a slightly different route (and it will nearly all be buried instead of being carried above ground on supports). Cost of the Alaska Highway Gas Pipeline Project, in total, is now estimated at over $23 billion.

In Canada, focus most recently has been on the proposals to deliver natural gas to Quebec and the Maritime provinces. Competing Q&M Pipelines and TransCanada PipeLines projects were combined, resulting in a plan to build 960 miles of main lines and laterals at a cost of $900 million

1980 Pipeline Construction
(Estimated Miles Completed During Year)

	U.S.	International	Total
Gas			
Transmission	3760	3490	7250
Field, Gathering, Storage	1200	1800	3000
Total	4960	5290	10250
Crude			
Trunk	1121	3080	4201
Gathering	640	1700	2340
Total	1761	4780	6541
Products			
Refined Products	907	1490	2397
LPG/NGL	560	1710	2270
Total	1467	3400	4867
Offshore			
Oil	194	710	404
Gas	486	525	1011
Total	680	735	1415
GRAND TOTAL	**8888**	**14205**	**23073**
Prime Movers			
(Estimated Horsepower Installed During Year)			
Compressor	323,000	808,000	1,131,000
Pump	255,000	380,000	635,000
Total	**578,000**	**1,188,000**	**1,766,000**

($300 million in Quebec, $600 million to expand TCPL's pipeline in the western provinces). Canada's Minister of Energy Marc Lalonde recently said the line to Quebec City would be built, but further extensions were being deferred. The Polar Gas Project has been reviewed again, and the project has another new plan—one that will require choosing from four competing proposals for the line that will reach into the High Arctic Islands and connect with a Y line extending west to the Beaufort Sea area and east to Melville Island.

In the U.S., products pipeline activity again dominates the construction scene. Mapco has awarded contracts for 1190 miles of 4- thru 12-in. lines from Rock Springs, Wyo. to Hobbs, N. Mex. to expand its natural gas liquids system. Santa Fe Pipelines has also announced for 1981 construction a 700-mile, $75 million 10- to 14-in. line from Hobbs, N.Mex. to the Gulf Coast near Houston. Other major products pipeline projects underway include Hydrocarbon Transport Inc.'s 210 miles in Kansas; Phillips Pipeline's 428-mile, 16-in. line from Borger, Tex. to Paola, Kans.; and Colonial Pipeline's 141 miles of 36-in. in Maryland and Delaware.

Crude oil pipeline activity was given a boost with the announcement that Wood River Pipe Line, a joint venture of Koch Oil and Williams Pipeline Co., would build 450 miles of 20- and 24-in. oil line from Wood River, Ill. to Bethany, Mo. to Mason City, Iowa. Work is underway. Pacific Coast Pipe Line, a new firm headquartered in Houston, announced plans to build a $1.3 billion, 1,107-mile, 36-in. line from near Taft, Calif. to Midland, Tex. Project does not include a lateral to coastal port, but that could be added in the future. Northern Tier Pipeline's proposed 1,491-mile, 40- and 42-in. system from Port Angeles, Wash. to Clearbrook, Minn. is in the final stages of clearing out the permitting process and arranging financing; proponents are hopeful of having a green light for the project by late autumn.

Major gas pipeline projects on the books include the 695-mile, 36-in. Rocky Mountain Pipeline from the Rocky Mountain Overthrust Belt area to California; the Trailblazer project from the same area to the Midwest, involving 840 miles of 30- and 36-in. pipe, and the Trans-Anadarko Project from western Oklahoma and the Texas Panhandle to Louisiana (United Energy Resources), involving 635 miles of 30- or 36-in. pipeline. Also planned are 115 miles of 30-in. loops by Texas Eastern, 163 miles of 16-in. in Texas by Northern Natural Gas, and 440 miles of 20-in. by Ozark Gas Pipeline Corp. in Oklahoma, Texas, and Arkansas

Internationally, the spotlight most recently has fallen on Brazil, where Petrobras has awarded a contract for 280 miles of offshore 12- to 24-in. line in the Campos Basin, 200 miles northeast of Rio de Janeiro, that is to be completed by early 1984. Another 60 miles is reportedly still planned. Cost is $95 million. In the United Kingdom, British Gas Corp. has awarded contracts on about one-half of the 280 miles of 42-in. to be built from St. Fergus, Scotland to Bishop Aukland. The 1980 work includes an 11-mile crossing of the Firth of Forth and a 4.7-mile crossing of the River Tay.

In the North Sea, only about 98 miles of 16-, 18-, and 24-in. line are planned—involving four different fields. Continuing studies are being made on proposals for a 625-mile, large diameter (at least 36-in.) gas line from Statfjord to the northern European coast. The Middle European Gasline (MEGAL) system is to be operational by the end of 1980 with completion of facilities in France, West Germany, and Austria. The Trans-Mediterranean Pipeline, stretching 1500 miles from Algeria's Hassi R'Mel field to northern Italy via Tunisia and Sicily, is well on or ahead of schedule on all sections. All three lines across the Sicilian Strait will be installed this year (each is 20-in., 100 miles long, laid to a depth of 1,995 ft at the deepest point).

With Algeria's Sonatrach apparently moving away from export of LNG, the SEGAMO gas line proposal involving 600 miles of pipeline across the Mediterranean from Algeria to Spain and France remains alive. A new plan reportedly will surface on this project in late 1980 or early 1981. Sonatrach is also reportedly ready to award contracts on two major gas pipelines, one a 318-mile, 42-in. line from Hassi R'Mel to Arzew, the other a 620-mile, 42- and 48-in. line from Alrar to Hassi R'Mel.

And, finally, the capacity of the SUMED oil pipeline running parallel to the Suez Canal may be greatly increased at the request of Saudi Arabia. When the east-west Petroline is completed, greatly increased amounts of crude may move from Yanbu to the SUMED southern terminal for transit to loading at the Mediterranean terminal. Such a capacity increase would almost certainly require additional pipeline construction.

Unflickered by the downturn experienced by some U.S. industries, America's blue flame burns even brighter, fanned by strong supply and demand for gas, record-breaking expenditures to accommodate both, and increased maintenance budgets to keep the nation's 1.3 million miles of gas distribution mains and services in good working order.

There's a ripple effect from all this—for once, positive—and the industry's equipment manufacturers and suppliers are enjoying the sensation.

That ripple has been noted at the top and confirmed by PIPELINE & GAS JOURNAL'S market research group (May P&GJ, pp. 20-22). American Gas Association anticipates more than $300 billion in gas industry expenditures between 1979 and 2000, of which a projected $88 billion—more than $4 billion annually, excluding the cost of the Alaska Gas Pipeline—will go into construction and maintenance of cross-country gas pipelines and utility mains and services.

A recent P&GJ study shows that the industry plans 349,000 miles of all types of lines before 1990 and will spend more than $70 billion to build them; in the distribution field, $33.7 billion is estimated for construction of 293,000-plus miles of mains and services in the next 10 years.

Budget figures lead to the conclusion that more people want gas, that the required extensions will cost more money—and that inflation is having its effect. Other figures are worth examining:

Demand statistics, even with a slump in new housing construction, still managed to register the sharpest rise in 30 years, according to A.G.A., and indicate sustained market growth in 1980. The Association expects 700,000 new hook-ups this year (there were 550,000 in 1979), increased gas sales to industry (up 14% last year), and growing numbers of residential customer conversions from oil to gas (225,000 in 1979, up 59%).

Gas supply will meet that demand. Dr. Henry Linden of the Gas Research Institute says the U.S. has enough for 40 years at current consumption rates, likely to increase to 65 to 70 years with renewed drilling. The U.S. gas industry added 14.3 trillion cubic feet of reserves in 1979, up 35% over 1978, and although there is still a gap between additions and current domestic production—about 5.5 Tcf last year—industry experts believe that Overthrust Belt and Alaskan volumes will eventually make up the difference.

Peakshaving gas supplies are ample—69.86 billion cu ft as underground gas storage, propane-air, peakshaving LNG, and other supplemental fuels during winter 1979-80, up from 68.62 Bcf the year before—and were especially so given the mildness of the last heating season. Major U.S. utilities such as ANR Storage Co., National Fuel Gas Corp., Washington Natural Gas Co., and others will spend more than $285 million in 1980 for underground gas storage and related facilities.

Plastic pipe sales and usage continue to increase, clearly dominating the new and replacement pipe market. This year, 78% of all distribution piping will be plastic, a remarkable figure in a field once held by steel pipe and tubing (only 12% of that field was plastic in 1966). More and more utilities report using plastic, especially polyethylene, as their primary distribution material. According to P&GJ's latest survey, 95.1% of all U.S. companies will use the material in 1980.

U.S. GAS DISTRIBUTION PIPING—1980-1989

Projection	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Miles of Gas Mains Installed	13,448	14,000	14,900	14,800	14,400	14,600	14,200	14,200	14,700	15,100
Miles of Gas Services Installed	13,798	14,000	14,200	14,600	14,700	15,000	15,600	15,550	15,900	15,900
Total	**27,246**	**28,000**	**29,100**	**29,400**	**29,100**	**29,600**	**29,800**	**29,750**	**30,600**	**31,000**
Construction Expenditures, Distribution ($Billion)	1.781	2.049	2.381	2.646	2.987	3.402	3.870	4.299	4.872	5.370

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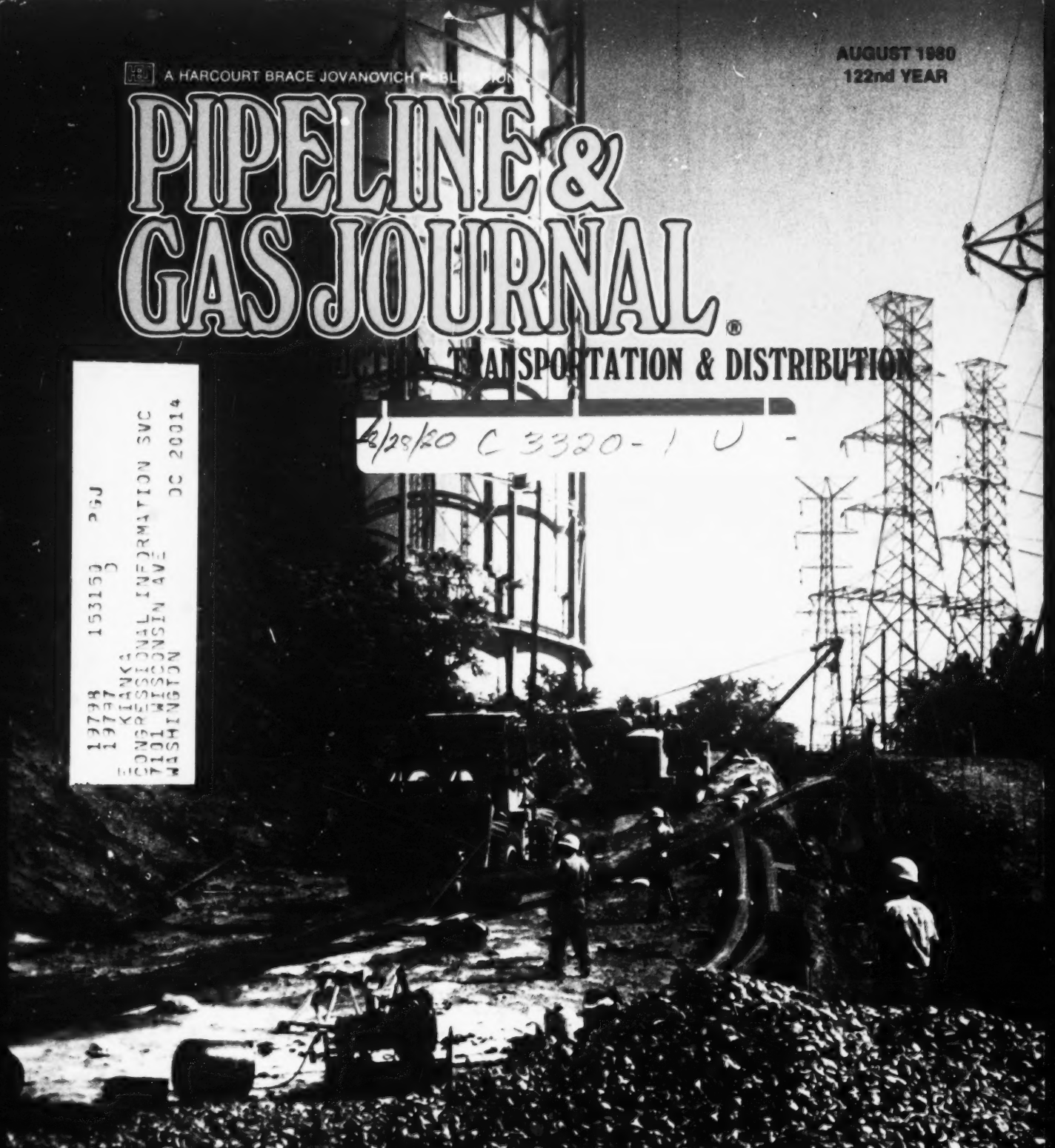

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International Pipeline & Gas Utility Design, Construction & Operation

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THE COVER

Workmen prepare 12-in. PE plastic pipe for insertion into 16-in. C.I. main as a river crossing pipe replacement. Story on page 19.

—Photo courtesy Public Service Electric & Gas Co.

River Crossing Replaced With Plastic ... 19
Public Service Electric and Gas Co., faced with having to repair or replace a pair of 16-in. cast iron pipe river crossings, elected to line them with 12-in. plastic inserts, using ultra-high molecular weight, high density polyethylene pipe.

System Replacement By Insertion 22
Michigan Consolidated Gas Co. began a program in the early 1970's of area renewals of its low pressure cast iron systems; the program has spread from the downtown Detroit area outward into suburban areas and is expected to accelerate in coming years.

Quick & Easy Service Replacements 25
Northern Illinois Gas Co. has developed a replacement method, developed for its copper tubing services that had to be replaced, in which the old copper service is removed by pulling and a new one installed in the same space, using a plastic-aluminum composite (PAC) tubing or polyethylene plastic tubing.

Vacuum Excavating 32
Citizens Gas & Coke Utility of Indianapolis is reducing operating costs and speeding the abandonment of inactive services by using a technique involving a vacuum excavator, one-foot square excavations, and specialty tools.

AGTL Testing Pipeline Inspection Pigs .. 43
How good are the electromagnetic pipeline inspection tools in detecting pipeline corrosion and mechanical damage? Alberta Gas Truck Line Co. Ltd. has a full-scale evaluation program underway to find out.

Dow Initiates Damage Program 46
Intensive "check before you dig" educational program implemented by Dow and its pipeline operations is aimed at preventing damage to pipelines by outside contractors.

Band Repair Clamp For Plastic..... 50
Ordinarily, damage to buried plastic pipe requires repair by replacement, regardless of amount of damage; Wisconsin Gas Co. research has helped develop a suitable stainless steel, full-encirclement band clamp for use as a permanent repair when the plastic pipe has only limited damage.

What's New in Repair/Maintenance 58
Latest ideas in materials and equipment for use in keeping facilities operating and in good order in both pipeline and gas distribution utility operations with full details available by simply using this issue's *Reader Service Card.*

New Approach For Odorization..... 62
Precise odorization control is now being used by Northwest Pipeline Corp. on three of its laterals to city gate stations; system uses vortex-shedding flowmeters to keep odorant injection rate proportional to the gas flow rate in the pipeline.

FINANCIAL NOTEBOOK

Money Market, Mergers, Acquisitions, Executive Changes, Capital Expenditures

Acquisitions. *Sun Co.* acquired *Viking Oil Ltd.* (London) for $33.4 million. Viking's main asset is 20% interest in certain North Sea oil/gas blocks.

Gulf Oil agreed to sell its 45% interest in *Okinawa Sekiyu Seisei*, which operates a 100,000 b/d refinery, to *Idemitsu Kosan* of Tokyo. Idemitsu now will own 90% of the refinery.

Nugget Oil Corp. agreed to acquire *Chaparral Energy Development Corp.* for 2.9 million common shares worth about $5 million.

Monument Energy Corp. agreed to acquire 80% interest in *Farmington Well Service*, which operates 12 rigs in Four Corners area of Southwest. Monument has 4-year option to acquire the remaining 20%.

Texas American Energy Corp. (Midland) agreed to buy *Western Kentucky Gas Co.*, an intrastate gas distributor, for about $23 million.

Briefs. U.S. *Export-Import Bank* okayed a loan of $4 million at 9%/yr to Blockfor, an Argentine firm, for purchase of a $9.3 million drilling rig from *Dresser Industries*. Blockfor is joint venture of *Astrafor* (Buenos Aires) and *Blocker Energy Corp.*

TOTAL (Cie. Francaise des Petroles) signed production sharing agreements with *Sonangol*, state oil concern of Angola, for a 4800-sq-km offshore block, and with *Petroci*, state oil concern of Ivory Coast, for a 6000-sq-km block partly onshore and partly on continental shelf.

Williams & Associates Security Consultants opened an Executive and Public Figure Protection Academy in Castle Rock, CO. offering courses in anti-kidnapping systems, evasive driving, movement security measures and defensive firearms tactics.

Rial Oil Co. holders approved a name change to *Sage Energy Co.* and an increse in shares from 5 million to 20 million.

Pecten Arabian Ltd. (Shell Oil) and *Saudi Basic Industries Corp.* (SABIC) agreed on terms for new $3 billion petrochemical complex to be built at Jabail Industrial City, Saudi Arabia. Complex is scheduled to be in operation late in 1985.

Proposal for construction of $3 billion in petrochemical plants was made to State of Alaska by *Dow Chemical Co.* Other companies involved would be *E.I. duPont de Nemours*, *Shell Chemical* and *Asahi-Dow* (Japanese affiliate of Dow Chemical). Construction project could create 2500 new jobs and $600 million additional taxes and royalty income to Alaska.

Pertamina, Indonesian oil monopoly, said *UOP Inc.* will provide engineering design to expand capacities in two Indonesian refineries in Java and Kalimantan by 200,000 b/d each.

Gasoline prices around the world in table below are from *ENERGY WEEK*, a sister newsletter publication. Write Brenda Norris, Box 1589, Dallas, TX 75221 for free sample copy.

Money markets. *Amarex, Inc.* privately placed $60.5 million of 12% non-recourse secured notes,

INTERNATIONAL FUEL PRICES per U.S. gallon FOR VEHICLES AT THE PUMP

Country	Regular Price[2]	Regular Taxes	Premium[1] Price[2]	Premium[1] Taxes	Diesel Price[2]	Diesel Taxes	Unleaded Price[2]	Unleaded Taxes
Austria	$2.30	$1.22	$2.51	$1.22	$2.31	$1.09		
*Bangladesh	2.02	0.27	2.07	0.29	0.74	0.07		
Belgium	2.91	1.52	2.98	1.52				
*Belize	1.355	0.224	1.435	0.223	1.225	0.10		
*Bermuda	1.94	0.57	2.07	0.57	1.29	0.076	none	none
*Brazil	2.35	0.24	3.49	0.32	1.03	0.09		
Britain	2.29	0.99	2.33	0.99				
Bulgaria	4.32							
Cameroon, Yaounde	2.22	0.44	2.40	0.48	1.87	0.44		
*Canada, Ottawa	0.82	0.248	0.917[3]	0.254[3]	0.833	0.286	0.875	0.248
*Colombia, Bogota	0.725	0.248	0.906	0.305	0.725	0.19	none	none
*Cyprus, Nicosia	2.59	0.97	2.83	0.97	0.99	none	none	none
Czechoslovakia			2.65					
*Denmark	3.41	1.99	3.45	1.99	1.94	0.56		
Dubai, UAE	1.39							
*Ecuador	0.18	0.06	none	none	0.14	0.01	none	none
Egypt	0.69							
*El Salvador	1.97	0.257	2.04	0.257	1.26	0.0258		
*Finland	2.76	1.08	2.88	1.04	1.95	0.62		
*France	2.97	1.70	3.17	1.81	2.23	1.035		
*West Germany	2.49	1.25	2.60	1.26	2.49	1.19		
East Germany	3.43							
*Greece	2.69	1.14	2.99	1.34	1.09	0.14		
*Rep. of Honduras	1.635	0.20	1.775	0.20	0.905	0.025	none	none
Hungary	2.60							
*Iceland, Reykjavik	3.57	1.98			1.39	0.03		
*India	2.07	1.18	2.15	1.18	0.74	0.21		
*Indonesia	0.606		0.848		0.212		none	none
*Iran	0.54		0.67		0.135			
*Ireland	2.64[4]	1.08	2.69[4]	1.08	2.19[4]	0.63		
*Israel	2.89		3.07		1.20			
*Italy	3.12	1.91	3.19	1.92	1.49	0.30		
*Jamaica	2.12	0.79	2.16	0.79	1.21	none	none	none
Japan	$2.75							
Kenya, Nairobi			$2.78					
Luxembourg	2.28	$1.03	2.33	$1.03				
Netherlands	2.60	1.44	2.67	1.44				
*New Zealand	1.74	0.50	1.80	0.50	$1.22	$0.03	none	none
*Nicaragua	1.98	0.824	2.25	1.042	1.180	0.056		
*Pakistan	1.70	0.72	1.99	0.67	1.07	0.24		
*Philippines	1.41	0.53	1.51	0.58	0.85	0.11		
Poland	2.10							
*Qatar	0.234	none	0.394	none	0.159[5]		none	none
*Romania	2.46		2.65		2.08			
*S. Africa	2.40	0.575	2.46	0.577	0.70	0.485		
Spain[6]	2.68		3.12		1.17			
*Sweden	2.32	1.25	2.36	1.25	1.04	0.10	$2.38	$1.25
Switzerland	2.66	1.34	2.68	1.34				
*Taiwan	1.47	0.21	1.58	0.25	0.74	0.10		
*Thailand	1.38	0.57	1.45	0.60	0.89	0.13		
*Trinidad & Tobago	0.25	0.03	0.34	0.06	0.29	0.02		
*Turkey	2.33	0.28	2.65	0.33	0.95	0.18		
U.S.S.R.	2.85[6]							
U.S.A.[7] Full-Service								
New England	1.227	0.13	1.306	0.13			1.270	0.13
Mid Atlantic	1.257	0.13	1.324	0.13			1.296	0.13
Great Lakes	1.280	0.133	1.318	0.133			1.320	0.133
Midwest avg.	1.254	0.124	1.322	0.124			1.295	0.124
Southeast avg.	1.246	0.12	1.304	0.12			1.283	0.12
Southwest avg.	1.206	0.107	1.288	0.107			1.244	0.107
West avg.	1.268	0.12	1.313	0.12			1.304	0.12
Overall avg.	1.256	0.123	1.312	0.123	1.136		1.295	0.123
Gasohol avg.	1.291							
*Uruguay	3.25	1.23	4.07	1.62				
Yugoslavia	2.80							

*Official source. [1]Unleaded or leaded premium gasoline. [2]Price includes taxes. [3]Unleaded. [4]Also includes 10% Value Added Tax (VAT). [5]Private use price 15.9¢; commercial price 56.2¢/gal. [6]Estimate. Not based on official exchange rates. [7]American Auto Association (AAA) figures for price/gal. [e]Estimate.

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with 10% net profits royalty interest to be paid out of the company's interest in three private drilling programs.

Tucker Drilling Co. sold 450,000 common shares for about $4.6 million through underwriters led by Rauscher Pierce Refnes.

Summit Energy Inc. sold 600,000 convertible preferred shares for $12 million .... *Brady Energy Corp.* filed offer of 1 million preferred shares, each convertible into 4 common shares or exchangeable for net revenue from sale of 4 bbl of heavy oil from the firm's Alberta property.

Toledo Mining Co. sold 71,119 common shares of American Resources Management Corp. for $3.4 million. Toledo Mining acquired the shares in May 1978 when ARMC bought certain oil/gas leases in Colorado from TM.

India will buy Canadian oil and natural gas exploration equipment and services with a new $15 million (Cdn.) line of credit extended by the *Canadian International Development Agency*. The agency (handles Canada's foreign aid) said money is interest free and repayable over 50 years.

Crystal Oil is offering $35 million in subordinated debentures due July 15, 2000 through *Smith Barney, Harris Upham & Co.* and *E.F. Hutton & Co.* ... *Amarex Inc.* will sell $30 million in sinking-fund debentures due 2000 through *Donaldson, Lufkin & Jenrette Securities Corp.*

Armco Inc. will sell to sell the 1.9 million shares of $2.4375 cumulative convertible preferred stock of *Rowan Cos.* it acquired two years ago. Each preferred share is convertible into about 1.43 Rowan common shares.

Drilling programs. *McCormick Oil & Gas Co.* sold its 1980 drilling program for $24 million. Company and its corporate partners will make additional investments bringing to $31 million the amount available to drill about 30 prospects this year.

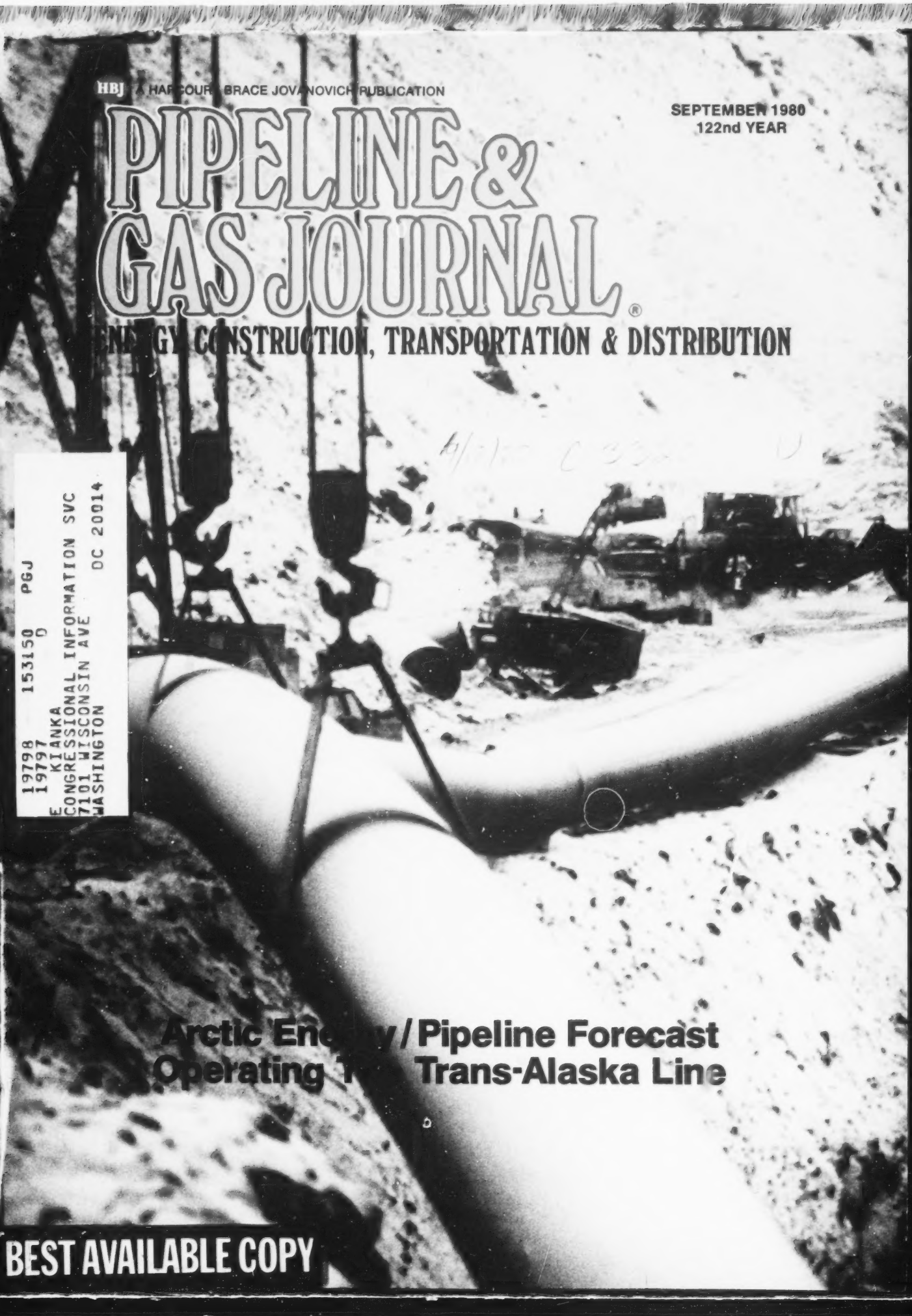
American Quasar Petroleum Co.'s Can-Am Drilling Programs Inc. unit closed its 1980-2 limited partnership at $40 million .... *Wainoco Oil Corp.'s* 1980 limited partnership was fully subscribed at $25 million. Operations will include some 50 prospects, most in U.S. Gulf Coast area.

Marline Oil Corp. completed a $16 million drilling fund with private investors .... *Nugget Oil Corp.* and *Rainy River Resources, Inc.* closed $840,000 offering on their 1980-1 drilling program.

Callon Petroleum Co. sold $12 million interest in a new limited partnership that will acquire royalties and mineral rights but won't drill wells. Callon will make another offering of up to $15 million in a similar royalty program for institutional investors.

General Electric Credit Corp. extended a $2.5 million loan to *CFI-Nevada 1979*, a California limited partnership, to underwrite drilling of some 20 wells in U.S. Southwest and Rocky Mountains.

Dyco Petroleum's second 1980 exploration offering of $25 million closed fully subscribed. It was the largest single offering in Dyco's history.



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PIPELINE & GAS JOURNAL

International Pipeline & Gas Utility Design, Construction & Operation

Published Continuously Since 1859

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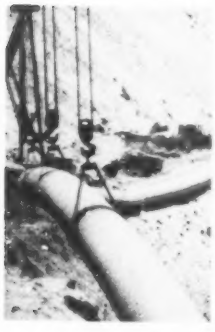

THE COVER

This year, America's eyes turn to the North as industry mobilizes to bring more Arctic Energy to eager markets in the Lower 48. Harsh environment, long nights, and permafrost will be overcome again — as they were here.

— courtesy Alyeska Pipeline Service Co.

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The regulatory logjam seems to have cleared, and nightmares about moving Alaskan gas to the Lower 48 can now become pleasant realities. Inside, a summary of progressing plans to tap Arctic energy.

Arctic Pipeline Operation A Different World 22

Operators in the Lower 48 have not had to worry about isolated, remote stations and camps, survival training, search parties, white-outs, limited availability of personnel, and adverse publicity about living conditions. Alyeska has.

Turbine Meters Prove Value With Extra-Wide Rangeability 32

Silver Bay, Minn., at the northern end of Northern Natural's pipeline system, may be a small community — but it boasts a modern city gate station and state-of-the-art gas metering whose rangeability increases with line pressures.

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Are they the right answer to vehicular traffic-caused stress and corrosive attack? Panhandle Eastern investigated to come up with a modern solution to the old problems.

What's New In Meters And Measurement Equipment? 56

Lots — but the trick is in keeping up with it. Inside, 23 useful products to help make the most of every MCF and barrel through accurate, reliable metering, recording, proving, and sensing.

Canadian Gas Co-op Assembles Own Equipment Spread 63

There are 76 independent gas cooperatives in Alberta, each formed to supply abundant, relatively inexpensive gas to rural areas and towns. One, St. Paul Lakeland, owns its own pipeline spread.

Congressional Corrections On Overseas Taxation Only 50-50 68

It began four years ago, when Congress got out its meat-axe to "get" wealthy American movie stars, lawyers, and businessmen who worked overseas for short periods. Now, the effect has been devastating to the construction and oil industries . . . .

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Alaskan Gas Breakthrough Nearing

by Dean Hale, *Editor*

Northwest Alaskan Pipeline's $7 million frost heave test facility near Fairbanks is testing various mitigative measures proposed to control frost heave encountered in permafrost regions. Chill pipes keep the test site ground frozen year-around to simulate conditions along the pipeline route.

With construction underway on segments of the prebuild sections of the 4800-mile Alaska Highway Gas Pipeline Project, the regulatory logjam appears to have been broken and nightmares about moving Alaskan gas to the lower 48 states can now turn to pleasant realities.

All necessary regulatory and government approvals in the U.S. and Canada were granted in mid-summer for early construction (pre-building) of certain portions of the overall system — in advance of the Alaskan section — to permit delivery of surplus Canadian gas to U.S. markets.

Portions being prebuilt are integral parts of the overall delivery system for Alaskan gas, and will involve construction of some 1888 miles of pipeline in the U.S. and Canada in the remainder of 1980 and during 1981. Prebuild sections in the U.S. will cost over $1.5 billion and will comprise the largest pipeline project ever installed in the lower 48 states.

Over 1 Bcf of Alberta natural gas will be transported per day for six years to U.S. markets. That includes up to 300 MMcf per day to be delivered to Southern California through the western delivery system and up to 800 MMcf per day to be transported through the U.S. eastern leg (Northern Border Pipeline) for midwestern, southern, and eastern U.S. markets.

The stage was set for the prebuild construction when the Federal Energy Regulatory Commission in June approved the western delivery system and issued a final order approving the Northern Border pipeline system. Approval by the Canadian government came in mid-July on the prebuild plan and for the required gas exports. Canada moved quickly for approval after being given assurances (in the form of a joint Congressional resolution) from the U.S., along with producer-sponsor agreements to fund final design and cost estimation and to negotiate a private financing plant.

Advantages of early pre-building, project spokesmen point out, are that the facilities added now will avoid higher inflationary costs of a later date, and earlier depreciation of facilities will result in a reduction of rate base and cost of service when Alaskan gas finally comes on stream. The total construction program will also be spread out over a greater period of time, lessening the impact of the project on availability of materials, equipment, capital, and manpower.

The $2.04 billion prebuild program involves 1888 miles of pipeline, including 555 miles in Canada — 132 miles on the western leg now and 28 miles within three years, plus 395 miles on the 42-in. eastern leg; plus 821 miles of 42-in. for the Northern Border system; 161 miles of 42-in. loops on Pacific Gas Transmission's system in Idaho, Washington, and Oregon; and 351 miles of 30 and 24-in. loop on Northwest Pipeline Co.'s system to permit handling 300 MMcf per day for delivery to Southern California via El Paso Natural Gas Co.'s pipeline system.

Plus A Touch of "1984" ...

Those who recall George Orwell's *1984* will shudder a bit when they hear what the federal government has planned for the pre-builders of the eastern and western legs: The "Federal Inspector" will have, effectively, control over nearly all decision-making — such as price, material selection, facility design, specifications, bidders' lists for materials and equipment, etc. *ad infinitum*.

In effect, the Federal Inspector will also serve as a one-window interface with all other Federal agencies — and some state agencies — with respect to the building of the overall Alaska Highway Gas Pipeline Project, and that includes the so-called eastern and western legs.

While it will, undoubtedly, be a king-sized headache for the pipeliners who will build the prebuild sections, it will "serve as good experience" for members of the Federal Inspector's team who will later oversee building the Alaskan section of the project.

Prebuild Details

Construction of the western and eastern legs of the prebuild sections of the Alaska Highway Gas Pipeline Project in Canada and the U.S. during the period 1980-81 will involve laying 1888 miles of pipe at an estimated cost of $2.04 billion.

The pre-build sections, to be utilized for the transportation of Alaskan gas to the lower 48 states beginning late in 1985, will initially provide for export of some 1.14 billion cu ft a day of Alberta gas to western and mid-western U.S. markets, rising to possible peak flows of 1.35 Bcf daily between 1983 and 1986.

In Canada, the pre-build sections will extend over a distance of 850 km (526 miles), cost an estimated $562 million, and require some 300,000 tons of 36 and 42-in. pipe. Estimated total value of materials and services required for

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Moving Arctic Energy To Market

Status of Projects and Proposals — September 1980

Type	Name	Size and Miles	Location	Status
Oil	Trans-Alaska Oil Pipeline	801 miles, 48-in.	Prudhoe Bay to Valdez	Completed and operating.
Oil	Northern Tier Pipeline Co.	1557 miles, 40 and 42-in.	Port Angeles, Wash. to Clearbrook, Minn.	Federal approval and all state approvals but Washington received; financing and permitting underway.
Gas	ALASKA HIGHWAY GAS PIPELINE PROJECT			
	Northwest Alaskan Pipeline Co.	743 miles, 48-in.	Prudhoe Bay to Alaska-Canada (Yukon) border	Final application for construction certificate made to FERC; expect approval by March 1, 1981
	Foothills Pipe Lines (South Yukon) Ltd.	232 miles, 48-in. 276 miles, 56-in.	Southern Yukon	Expect Canadian federal approval when Alaskan section is approved.
	Foothills Pipe Lines (North B.C.) Ltd.	444 miles, 56-in.	Northern British Columbia	Expect Canadian federal approval when Alaskan section is approved.
	Foothills Pipe Lines (Alberta) Ltd.	394 miles, 56-in. 234 miles, 42-in. 187 miles, 36-in.	Alberta	Expect Canadian federal approval when Alaskan section is approved. Prebuild sections involving 77 miles of 36-in. and 234 miles of 42-in. approved.
	Foothills Pipe Lines (South B.C.) Ltd.	105 miles, 36-in.	Southeastern B.C.	Approval given for prebuild construction underway on 55 miles of 36-in.
	Foothills Pipe Lines (Saskatchewan) Ltd.	161 miles, 42-in.	Saskatchewan	Approval given for prebuild; construction to get underway by spring 1981.
	Northern Border Pipeline Co.	821 miles, 42-in.	Monchy, Sask. to Ventura, Iowa	FERC approval given; construction to get underway in spring 1981.
	Pacific Gas Transmission Co.	160.5 miles, 42-in. in four loops.	Idaho, Washington, Oregon	FERC approval given on initial loop prebuild; construction to begin by
	Pacific Gas Transmission Co. and Pacific Gas & Electric Co.	721 miles, 36-in. and 42-in.		Awaiting FERC approval.
	Northwest Pipeline Co.	100 miles, 30-in. 10 miles, 24-in.	Oregon, Idaho	Approval given for prebuild construction; construction on loop underway.
		241 miles, 24-in.	Idaho	Loop on existing system; awaiting construction contracts.
	Foothills Pipe Lines	740 miles, 34-in.	Near Whitehorse to Mackenzie Delta area	Proposed; estimated cost $2.5 billion as of June, 1979.
	POLAR GAS PROJECT	2838 miles, 36 and 42-in.	High Arctic Islands and Mackenzie Delta to southern Canada	Project plans to file new application with National Energy Board by end of June 1981 for new "Y"-line.

construction of the two legs in Canada will amount to some $527 million.

Western Leg in Canada

Initial pre-building of the western leg involves installation of 215 km (132 miles) in seven loops on the existing Alberta Gas Trunk Line system in Alberta and on Alberta Natural Gas line in southern British Columbia. An additional 45 km (28 miles) of loops are to be added to the western system in 1983. All pipe is 36-in. No new compressor facilities will be required.

Construction of the loops will provide capacity for the export of Alberta gas through the pre-build facilities of up to 240 Mmcf per day between 1980-81 and 1981-82 and up to 300 Mmcf per day from 1983-84 to 1986-87. The pre-build system will transport gas from James River, Alberta, 100 km (60 miles) north of Calgary where the main line divides. The western leg runs southwest to Kingsgate, the B.C.-Idaho border point where it will join with the western leg facilities of Pacific Gas Transmission Co.

Total length of the system in Canada is 472 km (292 miles).

The loops, being built by Foothills Pipelines (Alta) Ltd. in Alberta and Foothills Pipelines (South BC) Ltd. in British Columbia, will eventually be filled to provide a continuous western leg pipeline for moving Alaskan gas to the western United States.

The three loops to be installed in Alberta are:

- James River to Elkton Creek, 33.3 km (20.2 miles)
- Cochrane-Elbow River area, 46.8 km (28.5 miles)
- Chain Lakes Park to Old Man River, 44 km (26.5 miles)

The four loops to be installed in South B.C. are:

- Crownsnest Pass, 4.16 km (2.9 miles)
- Flathead Ridge, 33.4 km (20.8 miles)
- Yahk area, 24.4 km (15.2 miles)
- Kingsgate-U.S. boundary, 26.7 km (16.6 miles)

Total authorized export through the pre-built western leg by Pan-Alberta Gas Ltd. on a firm and conditional basis between 1980-81 and 1987-88 amounts to 702.2 billion cu. ft. of gas.

U.S. Western Leg

From the border point at Kingsgate, B.C., gas will be moved southward to Stanfield, Oregon, by Pacific Gas Transmission through the addition of 160.5 miles of loops to its existing system. From Stanfield, the gas will be transported to southern California through the addition of some 565 km (351 miles) of loops to the Northwest Pipeline Co. system and by El Paso Natural Gas. PGT and Pacific Gas and Electric systems will eventually be paralleled for 911 miles over from Kingsgate to Antioch, Calif., near San Francisco.

PGT announced in mid-August that it had accepted the FERC certificate to build the 160.5 miles of 42-in. loops, to cost $186 million. The four major loops will be built in six sections. Section one is 40 miles in Idaho, with work to begin in December and completion by mid-May 1981. Bids are to be taken in October and contracts awarded in Novem-

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Pipeline & Gas Journal

ARCTIC ENERGY/PIPELINES

September 1980

ber. Sections two and three in Washington and section four, from the Oregon-Washington border to Stanfield, Oregon, will be awarded in 1981.

Some $60 million in pipe orders has been awarded — Kaiser Steel will provide 61,000 tons of 42-in. pipe, and Bethlehem Steel will provide 20,000 tons. Deliveries are to begin in late November.

Eastern Leg in Canada

Pre-building of the eastern leg in Canada calls for 635 km (395 miles) of 42-in. pipe as part of a continuous, independent system stretching southeasterward from James River, Alberta, to the border point at Monchy, Saskatchewan. The line joins there with the U.S. eastern leg being built by the Northern Border Pipeline Company.

Construction of the eastern leg is planned to begin in the spring of 1981 with the line to go into operation in November with a capacity for the delivery of 900 Mmcf per day. Capacity for throughput between 1982-83 and 1985-86 will increase to a peak of 1.05 billion cu. feet daily.

The system in Alberta, to be built by Foothills Pipelines (Alta) Ltd., extends for 377 km (234 miles) from James River, Alberta to Empress, Saskatchewan. From Empress, the line runs 258 km (161 miles) to Monchy, Saskatchewan, and is being built by Foothills Pipelines (Sask) Ltd.

Four turbine-driven compressor units will be installed on the eastern leg in Canada, two at a station near Jenner, Alberta; a third near Piapot, Saskatchewan, and a fourth near Monchy.

Cost of pre-building the eastern leg in Canada is estimated at approximately $427 million.

Total authorized exports through the pre-build on a firm and conditional basis over the period from 1981-82 to 1987-88 amount to 1.6 trillion cubic feet.

U.S. Eastern Leg

Pre-building of the eastern leg in the United States will involve construction of 821 miles of 42-in. pipe by Northern Border Pipeline Co. from Monchy to Ventura, Iowa. The line will eventually be extended to Dwight, Illinois, providing transportation for Alaska gas over a distance of 1129 miles. Estimated cost of the pre-build is $1.2 billion.

Northern Border plans to begin construction in the spring of 1981, with work on all nine spreads to get underway almost simultaneously.

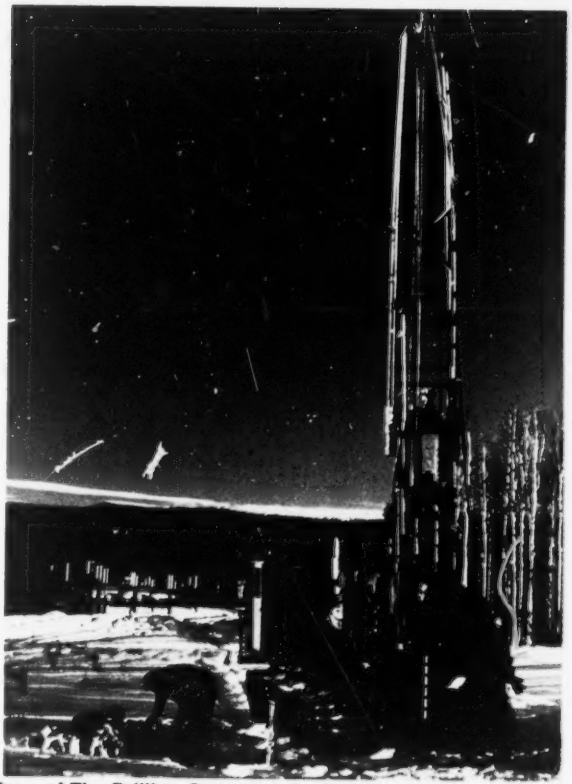
Pipe quotations from around the world are currently being reviewed and contracts for pipe are expected to be let in late 1980. Pipe will be double-jointed at storage sites along the route, with double-jointing to begin as soon as pipe deliveries begin.

Alaskan Pipeline Progressing

Two major filings were made July 1 by Alaskan Northwest Natural Gas Transportation Co., the consortium that will own the big gas pipeline between Prudhoe Bay and the Alaska-Yukon border. One was a supplement to a previous application to Department of Interior, requesting a single right-of-way grant for the pipeline through federal lands in Alaska. The line will traverse between 430 and 513 miles of federal land depending on the final resolution of pending land transfer cases.

The other major filing was to FERC seeking a final, unconditional Certificate of Public Convenience and Necessity authorizing construction of 743 miles of 48-in. and facilities, to cost $7.9 billion in 1980 dollars, exclusive of finance charges.

If the certificate is awarded by March 1, 1981, ANNGT—through Northwest Alaskan Pipeline Co., which will build and operate the line—plans to have construction complete in 1985, gas flowing from the conditioning plant by September 1, 1985, and gas flowing through the pipeline by November 1, 1985.



Crew of The Drilling Company, Anchorage, operates one of 17 drill rigs used in NWAPL's borehole drilling program, one of the largest field programs undertaken in preparation for building the Alaska Highway Gas Pipeline Project — soil samples collected for analysis will help determine frost heave potential along pipeline route.

Work on the pipeline itself would begin in February 1984. Civil construction work on the pipeline would begin in January 1983.

Involved in the pipeline plans are seven compressor stations, built on piled foundations, each having one 25,000-bhp gas turbine-driven compressor unit and two 10,000-bhp gas turbine-driven refrigeration units, with all equipment packaged and skid-mounted.

Two metering stations would be installed, involving five buildings on pile foundations, one at Prudhoe Bay and one at the Alaska-Yukon border.

Operation and maintenance facilities would be located at Fairbanks and at stations 2, 7, and 15; the latter would also serve as district headquarters locations.

Temporary facilities would include purchase of 16 pipeline camps and 8 station camps from Alyeska Pipeline Service Co. These would be renovated into 17 pipeline camps (14 to be used in place after renovation) with three to be relocated, plus seven camps to be used as station camps and relocated after renovation.

Of the 15 airfields required, 12 would have to be renovated. The Fort Wainwright offices in Fairbanks would also be completely renovated.

The communication system for the entire pipeline will be installed for and owned and operated by Northwest Alaska Pipeline.

The pipeline will involve 743 miles of 5LX-70 Arctic Grade pipe, 48-in. diameter, internally coated and externally coated with thin-film epoxy. Line will have 18,134 concrete weights and 24,320 ft of concrete coating. All double-jointing, coating, and insulation application will be done

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Over 1½-tons of documentation on the Alaska Natural Gas Transportation system represents filing by Northwest Alaskan Pipeline Co. to appropriate federal agencies for final certificate. Filing, made July 1, 1980, include 600 volumes of documentation plus 100 bound sets of drawings and represents a two-year design and estimating effort by NWAPL and project management contractor Fluor Engineers and Constructors, Inc.

in Fairbanks. Foreign sources would provide 75% of the pipe, U.S. sources 25%. Pipe is to be delivered internally coated.

Cost estimates are based on construction work at the work sites to be based on 7-day weeks at 10 hours per day, with staff work at 6 days per week and 10 hours per day.

Six construction sections are proposed, with one contractor per section.

Overall schedule for the project is:

3-1-81 Certificate granted.
4-15-81 Major engineered equipment ordered.
3-1-81 Unencumbered ROW grant given.
11-1-82 Majority of preconstruction activity completed.
1-1-83 Pipeline civil work to begin.
2-1-84 Mainline construction work to begin.
9-1-85 Mainline construction work complete.

Cost Estimate In 1980 Dollars

Compressor and metering stations	$ 693,073,000
Operation and maintenance facilities	53,428,000
Temp. facilities and services	886,707,000
Communications/supervisory systems	96,622,000
Pipeline	4,086,116,000
Project directorate	1,234,148,000
Normal contingency	846,006,000
Finance charge	894,300,000
TOTAL	$8,790,400,000

Selected Estimated Cost Items

Double-jointing of pipe	$ 29,700,000
156.3 miles of insulation	83,898,000
Thin film coating	60,206,000
Aerial crossings	25,262,000
Concrete weights, 1665 @ 13,500# each	
17,318 @ 25,000# each	11,922,000
24,320 ft of concrete coating	2,666,000
Workpad insulation	5,141,000
Workpad construction	38,246,000
Access roads	3,248,000
Construction equipment	356,127,000
Construction equipment parts and tires	193,396,000
Pipeline labor costs	426,829,000
Pipeline indirect costs	745,977,000

Alaskan Gas Pipeline— Major Equipment Requirements

Equipment	Peak Requirements
Backhoes—Crawlers	124
Compactors	94
Compressors	293
Concrete Plants	19
Cranes	236
Crushing & Screening Plants	11
Dozers	479
Drills—Air	86
Forklifts	28
Generators & Light Plants (30KW and Larger)	331
Graders	108
Loaders	201
Personnel Transportation	2,414
Pile Driving & Drilling Sets	16
Pipelayers	325
Pipeline Specialty Equipment	138
Pumps (4 in. and Larger)	132
Scrapers	123
Support Vehicles	934
Trenching Machines	5
Trucks—Heavy Duty	895
Welding Machines	945
TOTAL	7,937

NOTE: Equipment requirements listed above reflect anticipated requirements.

Polar Gas Project

Polar Gas, a joint public/private project sponsored by TransCanada PipeLines (the project manager), Panarctic Oils Ltd., Tenneco Oil of Canada Ltd., Petro-Canada, and the Ontario Energy Corporation, plans to file a new application with the National Energy Board by the end of June 1981 for a combined pipeline system.

Application will be for a "Y"-line that will connect substantial gas reserves of both the Arctic Islands and the Mackenzie Delta to market. Established gas reserves in the two areas are now considered sufficient to support a pipeline.

Polar Gas began studies in 1972 on transporting large volumes of frontier gas, with early studies concentrated on connecting gas reserves of the High Arctic Islands and moving to market. Application for a pipeline was filed with NEB in late 1977, proposing a line from Melville Island to Longlac, Ontario, following a route west of Hudson Bay.

Advances in deep sea pipelaying technology prompted Polar Gas to consider a new route involving fewer marine crossings. New route would allow Polar Gas to transport Arctic Islands gas via M'Clure Strait and Dolphin and Union Strait to the Canadian mainland. Deep water crossings would be reduced from five to two.

In 1979, after six years of Arctic research, Polar Gas undertook additional field studies of the new routing via these two straits. No technical obstacles to marine pipelining were encountered at either strait.

Polar Gas is currently evaluating four "Y"-line options on the mainland, and additional detailed studies to assist in final route selection and support of an application for a combined pipeline system are being undertaken this year. Studies are to be completed by the end of 1980. **P&GJ**

Higher Prices from Decontrol Boost Earnings

by Greg Martin, Editor
Energy News and Energy Week

Higher prices for oil and gas — with or without greater production — were the most influential factor in increased earnings for 100 oil companies surveyed by ENERGY MANAGEMENT REPORT. Production units of large gas companies surveyed also boosted earnings, though utility earnings lagged for some.

Oil firms' earnings were up 56.4% in first half of 1980 over the same 1979 period. Profit increase exceeded revenue increase despite initial effects of the "windfall profits" tax (WPT). Many firms had record results in both second quarter and 6-month periods. (For free copy of *ENERGY WEEK's* report on windfall profits write Greg Martin, Box 1589, Dallas TX 75221.)

Higher prices buoyed earnings of smaller companies most, though WPT limited all increases.

In one example of how WPT affected net gain, Superior Oil said price decontrol contributed $31.5 million before tax to cash flow available for investment. WPT reduced funds by $15.9 million; after federal income tax, net benefit of decontrol was $8.4 million in first half. Benefit is expected to be lower in second half as WPT will be in effect for the whole period.

North American operations accounted for 84% of Gulf Oil's first half profits. Earnings from U.S. exploration/production more than doubled due to higher prices, despite a net production decline. Texaco's U.S. earnings increase was partly offset by lower gross liquids output and lower gas sales.

Main factor in earnings gains for Atlantic Richfield and Standard Ohio was Alaskan crude oil operations. ARCO noted that a recent ruling by Department of Energy, requiring higher entitlements payments for North Slope oil, will

FIRST HALF GAS COMPANY FINANCIAL REPORTS

Company	Three months ending June 30** Revenues ($000) 1980	1979	% Chg.	Earnings* ($000) 1980	1979	% Chg.	Twelve months ending June 30** Revenues ($000) 1980	1979	% Chg.	Earnings* ($000) 1980	1979	% Chg.	Profit Margin† 1980	1979
Alabama Tennessee N.G.	20,124	15,230	+ 32.1	1,311	1,569	- 16.4	86,877	47,411	+ 83.2	5,154	3,974	+ 29.7	5.9	8.4
American Nat. Resources	590,117	516,621	+ 74.2	16,524	18,517	- 10.8	2,844,581	2,208,631	+ 28.8	116,548	92,167	+ 26.5	4.1	4.2
Coastal States	1,116,527	970,757	+ 15.0	28,590	25,702	+ 11.2	2,562,891[2]	1,957,828[2]	+ 30.9	54,981[2]	46,457[2]	+ 18.3	2.1	2.4
Columbia Gas	739,542	532,483	+ 38.9	30,629	27,230	+ 12.5	3,368,742	2,552,237	+ 32.0	151,341	132,043	+ 14.6	4.5	5.2
Commonwealth Nat. Res.	40,458	30,435	+ 32.9	1,041	1,055	- 1.3	189,326	129,986	+ 45.6	6,131	4,280	+ 43.2	3.2	3.3
Consolidated N.G.	464,856	392,273	+ 18.5	11,067	23,523	- 53.0	2,367,420	1,745,798	+ 35.6	117,918	110,089	+ 7.1	5.0	6.3
El Paso Companies	924,540	751,393	+ 23.0	6,131	40,723	- 84.9	1,952,928[2]	1,350,572[2]	+ 44.6	40,879[2]	72,012[2]	- 43.2	2.1	5.3
Enserch Corp.	617,744	488,731	+ 26.4	31,169	14,966	+108.3	1,312,431[2]	1,068,030[2]	+ 22.9	73,801[2]	45,827[2]	+ 61.0	5.6	4.3
Equitable Gas	198,940[2]	158,197[2]	+ 25.8	22,992[2]	18,609[2]	+ 23.6	324,761	260,691	+ 24.6	31,452	22,278	+ 41.2	9.7	8.5
Houston N.G.[1]	603,418	484,524	+ 24.5	56,031	37,839	+ 48.1	2,277,878	1,640,500	+ 38.9	188,562	127,986	+ 47.3	8.3	7.8
Internorth	603,871	523,083	+ 15.4	42,722	37,466	+ 14.0	2,832,839	2,123,270	+ 33.4	227,717	163,108	+ 39.6	8.0	7.7
Kansas Nebraska N.G.	75,651	71,641	+ 5.6	2,178	1,585	+ 37.4	345,482	303,761	+ 13.7	20,872	17,669	+ 18.1	6.0	5.8
Mountain Fuel Supply	224,889[2]	177,822[2]	+ 26.5	22,169[2]	15,700[2]	+ 41.2	381,851	307,475	+ 24.2	32,009	20,168	+ 58.7	8.4	6.6
National Fuel Gas	625,623[3]	511,462[3]	+ 22.3	30,169[3]	31,760[3]	- 5.0	730,871	580,114	+ 26.0	24,262	28,015	- 13.4	3.3	4.8
Northwest Energy	283,800	229,800	+ 23.5	10,700	7,600	+ 40.8	1,300,000	952,200	+ 36.5	51,300	31,500	+ 62.9	3.9	3.3
Oklahoma N.G.	205,506	154,767	+ 32.8	9,300	3,021	+207.9	821,790	665,374	+ 23.5	39,329	33,673	+ 16.8	4.8	5.1
Pacific Lighting	725,641	469,466	+ 54.6	22,855	21,723	+ 5.2	2,856,995	1,912,475	+ 49.4	91,406	90,240	+ 1.3	3.2	4.7
Panhandle Eastern	550,282	464,243	+ 18.5	37,842	32,513	+ 16.4	1,207,469	951,343	+ 26.9	98,720	85,056	+ 16.1	8.2	8.9
Peoples Energy	671,286	572,629	+ 17.2	25,700	24,100	+ 6.3	2,976,000	2,304,000	+ 29.2	141,300	131,800	+ 7.2	4.7	5.7
Pioneer Corp.	234,788	168,341	+ 39.5	22,390	16,473	+ 35.9	445,271[2]	326,155[2]	+ 36.5	45,820[2]	28,482[2]	+ 60.9	10.1	8.7
Southern Nat. Res.	399,859	327,990	+ 21.9	30,748	27,075	+ 13.6	1,735,454	1,258,236	+ 37.9	119,723	106,609	+ 12.3	6.9	8.5
Southern Union Co.	223,522	158,925	+ 40.6	8,562	5,388	+ 58.9	848,137	621,267	+ 36.5	40,933	24,552	+ 67.0	4.8	4.0
Texas Eastern Corp.	1,057,379	659,784	+ 60.3	55,569	38,851	+ 43.0	3,738,556	2,394,450	+ 56.1	203,601	150,378	+ 35.4	5.4	6.3
Texas Gas Trans.	511,124	380,787	+ 34.2	19,419	18,302	+ 6.1	1,096,457[2]	786,979[2]	+ 39.3	45,077[2]	34,508[2]	+ 30.6	4.1	4.4
TransCanada PipeLines	1,516,076[2]	1,199,708[2]	+ 26.4	47,322[2]	44,470[2]	+ 6.4								
Transco Companies	601,327	351,803	+ 71.0	27,228	16,405	+ 66.0	2,024,506	1,202,785	+ 68.0	92,398	58,591	+ 58.0	4.6	4.9
Union Gas Ltd.	146,294	131,770	+ 26.4	2,161	2,714	+ 25.6								
United Energy Res.	929,401	664,437	+ 39.9	37,096	23,214	+ 59.8	3,762,390	2,361,275	+ 59.3	140,869	89,075	+ 58.1	3.7	3.8
Westcoast Trans.							669,084[2]	504,808[2]	+ 32.5	25,351[2]	24,381[2]	+ 4.0	3.8	4.8
TOTALS	14,902,585	11,559,102	+ 28.9	659,615	578,093	+ 14.1	45,060,987	32,517,652	+ 38.6	2,227,454	1,774,918	+ 25.5	4.9	5.5

**Excluding non-recurring items. *Earnings available to common stock. †Ratio = Earnings ÷ Revenues. [1]Ends April 30. [2]Six months. [3]Nine months.

greatly raise refining costs for Alaskan producers, though it will reduce costs for other refiners.

"Upward price movements" were cited by Exxon for U.S. oil/gas operations. Improved worldwide earnings featured "better margins in foreign downstream operations." Conoco enjoyed "improved refined products margins overseas, higher crude oil margins in U.S. and increased crude oil production in North Sea."

Higher production earnings, both domestically and overseas, plus higher investment tax credits, boosted results of Union Oil. Phillips Petroleum credited greater output and higher prices worldwide for its improved first half. Marathon Oil said "all improvement in the 1980 second quarter resulted from activities in U.S." where net income more than doubled.

Standard California's domestic earnings benefited from higher prices and greater sales; lower margin on refined product sales abroad was more than offset by higher oil/gas prices and production. Socal said it paid almost $1.2 billion in taxes, more than double its after-tax earnings.

Cities Service said most business areas were ahead of 1979 levels in profitability though gas transmission volumes were lower. International energy results were "bolstered by profitable performance of the Syncrude tar sand operation in Canada."

Integrated oil operations showed greatest gain for Tenneco; shipbuilding earnings were stronger and gas pipeline division showed improvement.

Price increases were main reason for Ashland Oil's earnings rise. Amerada Hess had sharply higher production income, though refined product sales were down.

Oil/gas sales more than tripled for Seneca Oil due to higher prices and a significant increase in output from new wells coming on stream.

All segments of Natomas — oil production and marketing, coal, geothermal — set 6-month earnings records. Income from international petroleum operations more than doubled.

Record 6-month results for American Quasar were due to higher prices and a 27% increase in natural gas output from new discoveries and development of existing properties. Oil/gas sales rose 59% for Dyco Petroleum over first half of 1979 despite summer curtailment of gas sales.

North American operations brought higher income for Belco Petroleum, offsetting a decline in earnings from Peru.

Higher prices boosted revenues of Patrick Petroleum but net income fell because of high interest rates and lower sales by the firm's joint venture interests. Consolidated Oil & Gas blamed earnings decline on its equity share of losses of R.L. Burns Corp.

Refining/marketing operations were a mixed bag. Total Petroleum attributed sharp earnings gain to these operations. Investments in refinery upgrading led to a higher yield of light products.

Tosco's refining margins were strong throughout first half despite "unusually high gasoline inventories east of the Rockies."

Refining/marketing contributed greatest share of improved

FIRST HALF OIL COMPANY FINANCIAL REPORTS

		Three months ending June 30**				Six months ending June 30**				Profit Margin†	
		Revenues ($000)		Earnings* ($000)		Revenues ($000)		Earnings* ($000)			
		1980	1979 % Chg.	1980	1979 % Chg.	1980	1979 % Chg.	1980	1979 % Chg.	1980	1979
1.	Adams R&E	57,394	43,223 + 32.8	(1,839)	585 -	119,705	73,550 + 62.8	(1,957)	741 -	none	1.0
2.	Adobe Oil	38,690	20,252 + 91.0	4,956	3,050 + 62.5	74,775	37,795 + 97.8	9,337	5,020 + 86.0	12.5	13.3
3.	Amerada Hess	1,660,348	1,578,472 + 5.2	140,395	130,194 + 7.8	3,985,746	3,117,083 + 27.9	320,773	259,888 + 23.4	8.0	8.3
4.	American Petrofina	494,147	356,214 + 38.7	25,123	16,237 + 54.7	1,017,521	701,861 + 45.0	56,533	27,597 +104.9	5.6	3.9
5.	American Quasar	10,353	6,234 + 66.1	999	(144) -	19,428	13,178 + 47.4	3,004	481 +524.5	15.5	3.7
6.	Argonaut Energy	693	624 + 11.9	10	(27)					1.4	none
7.	Argo Petroleum	2,983	2,061 + 44.7	363	130 +179.2	6,212	3,962 + 56.8	837	135 +520.0	13.5	3.4
8.	Ashland Oil	2,158,666	2,337,120 - 7.6	46,542	395,432 - 88.2	6,284,821[3]	5,350,986[3] + 17.5	169,869[3]	473,362[3] - 64.1	2.7	8.8
9.	Asamera	80,068	54,726 + 46.3	2,919	3,399 - 14.1					3.6	6.2
10.	Atlantic Richfield	5,642,159	3,731,485 + 51.2	434,806	260,362 + 67.0	11,075,926	7,248,403 + 52.8	806,925	502,573 + 60.6	7.3	6.9
11.	Beard Oil	4,948	2,891 + 71.2	1,207	367 +228.6	10,657	5,914 +105.1	2,409	375 +542.1	22.6	7.2
12.	Belco Petroleum	199,637	129,983 + 53.6	18,761	16,801 + 11.7	411,180	255,250 + 61.1	37,004	31,206 + 18.6	9.0	12.2
13.	Brock Exploration	1,057	988 + 6.9	55	237 - 23.2					5.2	24.0
14.	C&K Petroleum	10,099	6,616 + 52.6	1,341	326 +311.3	18,762	13,137 + 42.8	2,462	700 +251.7	13.1	5.3
15.	Cities Service	1,814,300	1,425,300 + 27.3	107,000	76,700 + 39.5	3,986,300	2,870,900 + 38.9	277,100	155,200 + 78.5	7.0	5.4
16.	Clark O&P	431,167	276,736 + 55.8	11,246	9,442 + 19.1	833,441	534,934 + 55.8	25,346	15,529 + 63.2	3.0	2.9
17.	Commonwealth OR	298,000	321,000 - 1.7	(13,900)	37,700 -	604,000	557,000 + 8.4	(23,200)	48,100 -	none	8.6
18.	Consolidated O&G	8,049	7,491 + 7.4	(384)	1,566 -	16,008	14,418 + 11.0	(290)	(873)+ 66.8	none	none
19.	Conoco Inc.	4,700,000	3,000,000 + 63.3	249,600	215,800 + 15.7	9,000,000	5,800,000 + 55.2	578,200	377,600 + 53.1	6.4	6.5
20.	Crystal Oil	60,491	36,721 + 64.7	1,758	2,474 - 28.9	118,812	65,214 + 82.2	4,645	3,565 + 30.3	3.9	5.5
21.	Damson Oil	6,274	4,875 + 28.7	1,110	695 + 59.7	20,072[3]	13,044[3] + 53.9	2,160[3]	542[3] +298.5	10.8	4.2
22.	Delhi Int'l Oil	6,886	4,006 + 71.9	1,440	802 + 79.5	12,482	7,250 + 72.2	2,552	1,380 + 84.9	20.4	19.0
23.	Diamond Shamrock	769,130	574,225 + 33.9	56,346	52,965 + 6.4	1,524,461	1,079,230 + 41.3	112,601	82,494 + 36.5	7.4	7.6
24.	Dorchester Gas[3]	135,493	95,643 + 41.7	8,882	6,941 + 28.0	453,918[3]	242,868[3] + 86.9	25,215[3]	15,138[3] + 66.6	5.6	6.2
25.	Dyco Petroleum	6,845	5,033 + 36.0	1,919	991 + 93.6	12,963	8,606 + 50.6	3,530	1,783 + 98.0	27.2	20.7
26.	Earth Resources[2]	230,968	91,454 +152.5	8,024	4,610 + 74.1	373,797	178,658 +109.2	14,597	1,697 +118.0	4.0	3.7
27.	Energy Reserves Group	37,165	21,758 + 70.8	5,131	2,623 + 95.6	73,209	40,595 + 80.3	13,672	(466) -	18.7	none
28.	Equity Oil	3,666	2,783 + 31.7	948	623 + 52.2	6,970	5,450 + 27.9	1,789	1,167 + 53.3	25.7	21.4
29.	Exeter Oil	889	498 + 78.6	332	137 +141.7	1,753	878 + 99.7	555	141 +292.1	31.7	16.1
30.	Exxon	26,223,000	18,599,000 + 41.0	1,030,000	830,000 +24.1	53,877,000	37,427,000 + 44.0	2,955,000	1,785,000 + 65.5	5.5	4.8
31.	Felmont	14,940	10,062 + 48.5	4,201	1,820 +130.9	26,888	19,187 + 40.1	7,950	4,272 + 86.1	29.6	22.3
32.	Forest	21,863	14,240 + 53.5	538	448 + 20.1	43,327	32,014 + 35.3	2,661	2,535 + 5.0	6.0	8.0
33.	Galaxy Oil[2]	2,793	1,545 + 80.8	37	(287) -	9,387[4]	6,037[4] + 55.5	302[4]	(312)[4] -	3.2	none
34.	Getty Oil	2,643,318	1,149,225 +130.0	242,887	139,229 + 74.5	4,912,017	2,244,916 +118.8	468,435	247,156 + 89.5	9.5	11.0
35.	Great Basins[1]	6,433	4,781 + 34.6	(897)	189 -	16,862[3]	14,219[3] + 18.6	(2,918)[3]	1,434[3] -	none	10.1
36.	§Gulf Oil Corp.	6,800,000	6,108,000 + 11.3	370,000	291,000 + 27.1	14,556,000	11,674,000 + 24.7	759,000	540,000 + 40.6	5.2	4.6
37.	Hadson Petroleum	3,011	1,375 +119.0	897	228 +293.3	5,397	2,538 +112.6	1,572	474 +231.7	29.1	18.7
38.	Hamilton Bros. Petr.	28,610	29,708 - 3.7	6,902	3,187 +116.6	54,076	58,875 - 8.2	13,919	4,345 +220.3	25.7	7.4
39.	Helmerich & Payne	52,060	38,593 + 34.9	12,054	8,564 + 40.8	152,401[3]	111,520[3] + 36.7	34,436[3]	24,243[3] + 42.0	22.6	21.7
40.	Houston O&M	101,286	76,354 + 32.7	14,626	13,613 + 7.4	198,568	157,996 + 25.7	29,216	26,670 + 9.5	14.7	16.9
41.	Howell Corp.	69,746	68,172 + 2.3	2,166	7,171 - 69.8	139,032	127,004 + 9.5	10,322	9,894 + 4.3	7.4	7.8
42.	Inexco Oil	35,977	23,536 + 52.9	5,602	3,859 + 45.2	67,697	45,746 + 47.9	11,349	7,598 + 49.4	16.8	16.6
43.	Juniper Petroleum	5,786	3,861 - 3.7	556	316 + 75.9	12,639	6,691 + 88.9	2,047	468 +337.4	16.2	7.0
44.	KRM Petroleum	1,194	602 + 98.3	185	39 +374.4	2,402	1,087 +121.0	575	29 +1882.8	23.9	2.7
45.	Kerr-McGee Corp.	854,246	646,308 + 32.2	49,577	43,587 + 13.7	1,634,640	1,248,201 + 31.0	96,719	77,029 + 25.6	5.9	6.2
46.	Lear Petroleum	19,624	16,633 + 18.0	1,714	941 + 82.1	65,547[3]	55,377[3] + 18.4	5,340[3]	3,240[3] + 64.8	8.1	5.9
47.	Louisiana L&E	258,436	207,128 + 24.8	42,832	53,270 - 19.6	523,390	367,605 + 42.4	94,425	87,040 + 8.5	18.0	23.7
48.	MGF Oil	19,164	9,806 + 95.4	1,452	90 +1513.3	34,139	21,860 + 56.2	2,707	475 +470.0	7.9	2.2
49.	Mapco Inc.	197,707	189,108 + 4.6	22,455	17,967 + 25.0	437,449	341,846 + 28.0	43,043	31,323 + 37.4	9.8	9.2
50.	§Marathon Oil	2,039,893	1,591,911 + 28.1	108,325	84,831 + 27.7	4,305,261	3,065,600 + 40.4	247,396	189,305 + 30.7	5.7	6.2
51.	Marion Corp.	137,253	97,112 + 41.3	4,956	6,248 - 20.7	237,105	135,897 + 74.5	8,953	8,118 + 10.3	3.8	6.0
52.	May Petroleum	5,757	3,991 + 44.2	1,224	570 +114.7	11,083	6,996 + 58.4	2,577	9[illegible] +172.1	23.3	13.5
53.	Maynard Oil[2]	7,452	4,262 + 74.8	1,217	804 + 51.4	24,544[4]	16,495[4] + 48.8	3,751[4]	1,985[4] +136.7	15.3	9.6
54.	Mesa Petroleum	89,527	57,288 + 56.3	23,405	11,314 +106.9	190,105	112,686 + 68.7	42,991	25,671 + 67.5	22.6	22.8
55.	Mitchell Energy[1]	142,270	85,489 + 66.4	23,470	9,474 +147.7						
56.	§Mobil Corp.	15,396,680	10,707,963 + 43.8	687,856	418,783 + 64.3	30,675,163	21,110,210 + 45.3	1,533,460	867,345 + 76.8	5.0	4.1
57.	Murphy Oil	454,838	363,203 + 25.3	35,633	21,891 + 62.8	1,024,083	726,786 + 40.9	64,023	36,935 + 73.3	6.3	5.1
58.	Natomas	364,607	247,579 + 47.3	57,399	25,651 +123.8	683,683	467,436 + 46.3	105,414	43,926 +140.0	15.4	9.4
59.	Noble Affiliates	67,265	50,195 + 34.0	12,090	6,650 + 81.8	134,849	97,160 + 38.8	25,549	12,879 + 98.4	18.9	13.3
60.	Norris Oil	307	85 +261.2	10	(76)+113.2	551	179 +207.8	37	(121)+130.6	6.7	none
61.	Occidental Petr.	2,998,563	2,237,594 + 34.0	153,193	97,314 + 57.4	6,345,169	4,080,188 + 55.5	422,999	171,023 +147.3	6.1	4.2
62.	Oxoco	2,797	2,762 + 1.3	311	64 +385.9	5,434	4,561 + 19.1	562	111 +406.3	10.3	2.4
63.	Pacific Resources	179,983	108,988 + 65.1	4,871	1,851 +163.2	386,943	223,575 + 73.1	13,901	5,163 +169.2	3.6	2.3
64.	Patrick Petroleum[1]	13,583	8,987 + 51.1	1,049	1,461 - 28.2	43,029[4]	35,931[4] + 19.8	1,035[4]	3,107[4] - 66.7	2.4	8.6
65.	Pauley Petroleum[2]	43,144	31,868 + 35.4	(2,149)	2,901	126,601[3]	78,925[3] + 60.4	1,903[3]	(222)[3]		
66.	Peninsula Resources	3,511	2,460 + 42.7	260	(31)+938.7	6,851	4,347 + 57.6	405	88 +360.2	5.9	2.0
67.	Pennzoil Co.	630,996	493,242 + 27.9	77,648	58,023 + 33.8	1,243,901	926,663 + 34.2	161,284	104,196 + 54.8	13.0	11.2
68.	Phillips Petroleum	3,230,179	2,216,922 + 45.7	214,849	214,602 + 0.1	6,614,341	4,203,946 + 57.3	499,263	391,603 + 27.5	7.5	9.3
69.	Premier Resources	1,247	1,165	(9)	89	3,777	3,126	1,052	131		
70.	Quaker State	200,891	180,936 + 11.0	7,496	13,195 - 43.2	395,751	338,091 + 17.1	14,375	21,107 - 31.9	3.6	6.2
71.	Seneca Oil	2,077	632 +228.6	322	30 +972.0	4,807[3]	1,620[3] +197.0	661[3]	46[3] +1333.0	13.8	2.9
72.	Shell Oil	4,895,000	3,403,000 + 43.8	407,000	277,000 + 46.9	9,693,000	6,479,000 + 49.6	780,000	501,000 + 55.7	8.0	7.7
73.	Southland Royalty	92,336	61,469 + 50.0	15,386	11,802 + 30.0	182,971	112,829 + 62.0	34,186	21,907 + 56.0	18.7	19.4
74.	Standard Calif.	10,649,000	6,975,000 + 52.7	535,000	383,000 + 52.8	21,096,000	13,933,000 + 51.4	1,162,000	726,000 + 60.1	5.5	5.2
75.	Standard Indiana	7,300,000	4,600,000 + 58.7	488,200	350,200 + 39.4	13,700,000	9,000,000 + 52.2	1,064,200	700,200 + 52.0	7.8	7.8
76.	Standard Ohio	2,840,600	1,818,000 + 56.2	451,300	201,400 +124.1	5,499,300	3,468,500 + 58.5	902,000	368,908 +144.5	16.4	10.6
77.	Statex Petroleum[1]	1,596	917 + 74.0	317	150 +111.3	2,839	1,839 + 54.4	503	277 + 81.6	17.7	15.1
78.	Sun Co.	3,000,000	2,500,000 + 20.0	247,000	166,800 + 48.0	6,100,000	4,900,000 + 25.0	498,300	295,100 + 69.9	8.2	6.0
79.	Sundance Oil	3,631	3,044	(3,753)	(330)	7,915	6,988	(4,836)	(1,746)		
80.	Superior Oil	350,618	258,901 + 35.4	68,635	48,590 + 41.3	680,905	478,129 + 42.4	159,201	88,917 + 79.0	23.4	18.6
81.	Supron Energy	16,191	10,950 + 47.8	4,625	3,127 + 47.9	31,247	22,089 + 41.5	9,325	6,273 + 48.7	29.8	28.4
82.	Tenneco	3,201,000	2,704,000 + 18.4	186,000	153,000 + 21.6	6,517,000	5,151,000 + 26.5	364,000	276,000 + 31.9	5.6	5.4
83.	Tesoro	780,784	878,194 - 11.1	23,068	14,752 + 56.4	2,641,724[3]	1,704,090[3] + 55.0	99,066[3]	34,528[3] +186.9	3.8	2.0
84.	Texaco Inc.	12,539,000	8,503,000 + 47.5	502,937	337,458 + 49.0	25,788,000	16,861,000 + 52.9	1,103,516	641,391 + 72.1	4.3	3.8
85.	Texas American	33,079	26,799 + 23.4	521	1,360 - 61.6	66,216	49,326 + 34.2	1,207	1,577 - 23.5	1.8	3.2
86.	Texas Oil & Gas[2]	303,856	252,140 + 21.0	37,250	25,867 + 44.0	866,597[3]	643,072[3] + 35.0	101,292[3]	69,104[3] + 47.0	11.7	10.7
87.	Tipperary Corp.	20,852	15,520 + 34.4	1,681	1,319 + 27.4	58,957[3]	39,314[3] + 50.0	4,895[3]	1,307[3] +274.5	13.4	3.3
88.	Tomlinson Oil[2]	16,091	10,051 + 60.1	274	1,420 - 80.7	44,182[3]	22,651[3] + 95.1	2,504[3]	2,040[3] + 22.7	5.7	9.0
89.	Tosco Corp.	598,264	442,643 + 35.2	18,583	19,668 - 5.5	1,132,426	798,910 + 41.7	41,212	31,426 + 31.1	3.6	3.9
90.	Total Petroleum N.A.	326,531	205,392 + 59.0	18,291	4,591 +298.4	641,120	379,442 + 69.0	26,362	9,321 +182.8	4.1	2.5
91.	Transcontinental Oil	20,507	15,242 + 34.5	1,549	(1,594) -	38,497	30,022 + 28.2	1,425	(2,502) -	3.7	none
92.	Union California	2,648,001	1,764,146 + 50.1	194,817	128,242 + 51.9	4,930,334	3,426,479 + 43.9	347,739	242,346 + 43.5	7.1	7.1
93.	United Refining	166,350	111,437 + 49.3	2,147	3,478 - 38.2	315,634	213,606 + 47.7	4,394	6,704 - 34.4	1.4	3.1
94.	Universal Resources[1]	9,626	5,774 + 66.7	1,783	617 +189.0	18,913	11,418 + 65.6	3,155	1,230 +156.5	16.7	10.8
95.	Wainoco Oil	8,275	4,962 + 66.8	670	1,032 - 35.1	17,821	10,340 + 72.4	3,600	2,522 + 42.7	20.2	24.4
96.	Wichita Industries	2,618	1,624 + 61.2	602	144 +318.1	4,814	2,622 + 83.6	956	164 +482.9	19.9	6.3
97.	Williams Companies	574,511	525,597 + 9.3	52,278	26,720 + 95.7	1,053,848	947,730 + 11.2	87,401	34,159 +155.9	8.3	3.6
98.	Wilshire Oil of TX	14,095	12,686 + 11.1	672	532 + 26.3	29,095	25,258 + 15.2	1,425	1,063 + 34.1	4.9	4.2
99.	Wiser Oil	14,950	8,263 + 80.9	3,315	2,159 + 53.5	30,061	16,863 + 78.3	8,351	4,792 + 74.3	27.8	28.4
100.	Woods Petroleum	12,880	10,319 + 24.8	3,311	2,994 + 10.6	36,023	20,279 + 77.6	6,376	5,737 + 11.1	17.7	91.6
	TOTAL	132,682,826	95,160,153 + 39.4	7,599,759	5,797,386 + 31.1	270,523,600	186,600,583 + 45.0	16,948,141	10,810,847 + 56.8	6.3	5.8

**Excluding non-recurring items. *Earnings available to common stock. §Revenues include excise taxes. †Earnings* divided by Revenues. [1]Ends April 30. [2]Ends May 31. [3]Nine months. [4]Twelve months. ()Loss.

profits for American Petrofina. Production income also was significantly higher but limited by WPT. Higher retail gasoline prices offset lower fuel oil prices and higher crude costs for Clark Oil & Refining.

Pennzoil said the U.S. entitlements program puts refiners of Appalachian crude at a "severe competitive disadvantage," causing a decline in marketing income. Reason for Pennzoil's earnings gain was higher gas sales and higher prices on all production.

Louisiana Land & Exploration blamed second quarter earnings decline on lower refinery profit margin, caused by higher crude costs. United Refining could not recover rising crude costs and interest expense through higher product prices because of competitive conditions. Crown Central's sales were hurt by conservation of gasoline and distillate fuels.

Healthy coal operations and higher oil/gas prices brought record earnings for MAPCO. Greater than expected losses of coal division were main reason for Adams Resources & Energy's net loss. Coal operations also slumped for Ashland.

Reduced gas sales volumes, mainly to industrial customers because of the current recession, bit into earnings of some integrated gas companies. Still, earnings of the 29 firms surveyed rose 25.5% in the year ended June 30, 1980. Oil/gas production and contract drilling operations were increasingly profitable.

Earnings gains for InterNorth, Inc. were led by Northern Liquid Fuels division. Lower gas sales to large industrial users and warmer weather caused a 32% drop in earnings of Northern Natural Gas. Texas Eastern attributed higher income mainly to higher prices for North Sea oil and greater volume of domestic product sales.

Record second quarter for Texas Gas Transmission was due primarily to the company's inland waterways operations as the gas transmission unit had lower earnings. Southern Union's income gains were due to gas processing operations, which benefited from sharply higher prices for natural gas liquids (decontrolled).

Peoples Energy Corp.'s gas pipeline unit sold less gas to major distribution company customers. This, along with "mounting pressure" on take-or-pay gas purchase obligations, is expected to offset anticipated earnings gains in fourth quarter.

Enserch Corp. had higher production income due to higher prices and greater sales. Utility earnings benefited from off-system gas sales to other pipeline companies. Higher income for United Energy Resources reflected more gas sales by pipeline units and greater production by Cotton Petroleum subsidiary.

Oklahoma Natural Gas plans to spend about twice as much on nonutility as on utility operations over next three years as production, gas processing and contract drilling are more profitable. Record second quarter for Pioneer Corp. was credited to production gains, higher NGL prices and high demand for contract drilling services.

El Paso's second quarter earnings were hurt by cutoff of liquefied natural gas deliveries from Algeria. Cutoff is expected to cause "substantial adverse impact" until LNG is back on stream.

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OCTOBER 1980
122nd YEAR

PIPELINE & GAS JOURNAL

ENERGY CONSTRUCTION, TRANSPORTATION & DISTRIBUTION

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WASHINGTON DC 2001

$104 Billion Planned For World Pipelines

PIPELINE & GAS JOURNAL

International Pipeline & Gas Utility Design, Construction & Operation

Published Continuously Since 1859

in this issue

OCTOBER 1980 • VOLUME 207 • NUMBER 12

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THE COVER
Italian farmer keeps an eye on his flock as a major segment of the 48-in. Trans-Mediterranean Gas Pipeline takes shape in his pasture in Calabria section of southern Italy.

—photo courtesy Saipem s.P.a.

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World energy demand has created a need for more pipelines of all types; latest P&GJ survey indicates over 85,000 miles planned or underway — all of it outside the U.S. — at a total cost of over $104 billion.

Petroline Welded Out 22

Construction of the 787-mile, 48-in. crude oil pipeline running from east to west across Saudi Arabia has been completed; work on pumping stations and the Yanbu Terminal are progressing on schedule.

Aramco Line Nearing Completion 30

Big 747-mile 28/30-in. gas liquids pipeline, laid parallel to the 48-in. Petroline, has been welded out by contractor; east-to-west line also terminates at Yanbu facilities.

Trans-Med Gas Line Set For 1982 38

Castoro Sei, the huge semi-submersible pipelaying vessel, has completed two of three 20-in. lines between Sicily and Tunisia, may complete third line by Christmas; landlines in Algeria, Tunisia, Sicily, and southern Italy also being flanged-up.

French Gas Line Completed 46

Nozay-Neuvelle section of new gas pipeline between Nozay and Beynes storage field has been completed for Gaz de France.

Oil and Gas Lines Laid In Same Ditch ... 54

New 445 km, 18-in. crude oil pipeline extends transportation system in Oman southward to Marmul and new oil fields.

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A pioneering 3.85 km insulated, SECT-heated submarine pipeline near Ancona, Italy, connects Falconara Refinery with an unloading platform in the Adriatic Sea.

Enagas Operating First Gas Pipeline 69

New 730 km gas transmission pipeline is first — and major — segment of a 1020 km pipeline system that will supply gas to most of the industrialized areas of Spain.

Argentina Building 1730 km System 77

Giant $1.5 billion, 1730 km Cental-West gas pipeline project is getting underway in Argentina; pipe shipped in huge barge-loads from Netherlands; Cogasco consortium will operate line for 15 years after constructing it.

What's New In Construction Equipment 82

Showcase of recent innovations in construction equipment for pipeline contractors.

Denmark Plans 13,230 Km System 88

First section of ambitious Danish gas program will get underway in 1981 with building of a 24-in. major feeder.

Major part of the Trans-Mediterranean Gas Pipeline — the 230-mile 48-in. section across Tunisia from the Algerian border to Cap Bon that crosses desert areas — has been completed ahead of schedule.

High Global Energy Demand Stimulating World Pipeline Activity

by Dean Hale, *Editor*

World energy demand is producing a record demand for new oil, natural gas, petroleum products, and slurry pipelines, with nearly 85,000 miles planned or underway — at a cost of over $104 billion — around the world (outside of the United States), reveals PIPELINE & GAS JOURNAL's survey of world pipeline activity. The total figure of 84,559 miles includes 16,961 miles of planned or underway pipelines in the U.S.S.R., the Eastern Bloc countries, and the Peoples Republic of China. Excluded are 5500 miles of pipeline in Iran.

The world pipeline scene continues to change and 85,000-mile total reflects an astonishing record of completions on major pipeline projects around the world, including the 787-mile, 48-in. Petroline across Saudi Arabia and its parallel 747-mile natural gas liquids line for Aramco; the completion of two of Trans-Mediterranean Pipeline's 100-mile, 20-in. undersea crossings between Tunisia and Sicily as well as the major land segments across Algeria, Tunisia, Sicily and the southern tip of Italy; completion of the Middle European Gas Line (MEGAL) system in Austria, West Germany, and France; numerous oil, gas, and product lines in Mexico; and many major projects in the Middle East, North Africa, and Europe.

Even so, there is an exciting ledger of new projects on the drawing boards and under construction around the world.

P&GJ's survey indicates that natural gas pipelines account for 64.4% of the total pipelines now planned or underway — 54,465 miles of gas pipelines with 9456 miles under construction. Crude oil pipelines account for another 22.5%, with 19,035 total miles and 5293 being built. Products pipelines represent 10.6%, with 8931 total miles and 1309 miles underway and slurry pipelines represent 2.5%, with a total of 2128 miles planned.

INTERNATIONAL PIPELINE CONSTRUCTION — BY TYPE OF LINE

(As of September 1980)

	Miles		
Type of Line	Total	U/C	Planned
Gas	54,465	9,456	45,009
Crude	19,035	5,293	13,742
Products	8,931	1,309	7,622
Slurry	2,128	—	2,128
TOTALS	84,559	16,058	68,501

INTERNATIONAL PIPELINE CONSTRUCTION — BY COUNTRY

(Underway, Planned, and Proposed — September 1979) in Miles

	Miles of Gas Pipelines		Miles of Crude Oil Pipelines		Miles of Product Pipelines		Miles of Slurry Pipelines		Total Miles	
	Total	Underway	Total	Underway	Total	Underway	Total	Underway	Total	Underway
Abu Dhabi	368	230	860	860	—	—	—	—	1088	950
Algeria	2721	872	390	390	698	698	—	—	3809	1960
Argentina	2501	1084	300	—	12	—	88	—	2901	1084
Australia	1650	110	3	3	403	101	15	—	2071	214
Bangladesh	122	—	—	—	—	—	—	—	122	—
Belgium	109	—	—	—	—	—	—	—	109	—
Bolivia	2012	—	—	—	536	—	—	—	2548	—
Brazil	2741	—	1005	442	492	199	9	—	4157	641
Canada	9807	720	3738	146	1098	—	—	—	14643	866
Chile	564	—	20	—	—	—	45	—	629	—
China	1200	—	2200	—	—	—	—	—	3400	—
Colombia	500	—	370	250	165	40	—	—	1035	290
Congo	14	—	—	—	—	—	—	—	14	—
Czechoslovakia	535	535	—	—	—	—	—	—	535	535
Denmark	8220	—	—	—	—	—	—	—	8220	—
Dubai	—	—	17	—	—	—	—	—	17	—
Ecuador	478	162	6	—	—	—	—	—	484	162
Egypt	168	—	200	200	—	—	—	—	368	200
France	2330	1200	350	—	169	—	—	—	2849	1200
Greece	70	—	50	—	—	—	—	—	120	—
Honduras	—	—	160	—	—	—	—	—	160	—
Hungary	—	—	188	—	112	—	—	—	300	—
India	—	—	120	—	300	—	171	—	591	—
Indonesia	—	—	62	—	—	—	—	—	62	—
Iran*	*	*	*	*	*	*	—	—	*	*
Iraq	800	350	1322	—	684	—	—	—	2806	350
Italy	863	253	—	—	—	—	—	—	863	253
Japan	230	—	—	—	—	—	—	—	230	—
Kuwait	—	—	400	400	23	—	—	—	423	400
Libya	—	—	511	280	—	—	—	—	511	280
Malaysia	80	—	—	—	—	—	—	—	80	—
Mexico	2710	1560	750	572	427	51	—	—	3889	2133
Netherlands	6	—	—	—	100	—	—	—	106	—
New Zealand	100	—	—	—	93	—	—	—	193	—
Nigeria	—	—	75	—	—	—	—	—	75	—
Norway	600	—	—	—	—	—	—	—	600	—
Oman	140	—	510	—	—	—	—	—	650	—
Pakistan	1025	—	1625	1095	—	—	—	—	2650	1095
Panama	—	—	36	—	—	—	—	—	36	—
Poland	—	—	—	—	—	—	350	—	350	—
Portugal	—	—	—	—	69	—	—	—	69	—
Saudi Arabia	—	—	535	—	900	—	—	—	1435	—
Spain	84	—	30	—	288	220	—	—	402	220
Sudan	—	—	800	—	—	—	—	—	800	—
Sweden	186	—	—	—	—	—	—	—	186	—
Tanzania	—	—	—	—	678	—	—	—	678	—
Thailand	480	480	—	—	235	—	—	—	715	480
Tunisia	329	—	—	—	—	—	—	—	329	—
Turkey	105	62	670	—	—	—	—	—	775	62
United Kingdom	820	308	172	—	328	—	—	—	1320	308
USSR	8790	1500	1100	330	506	—	1450	—	11846	1830
Venezuela	85	—	—	—	—	—	—	—	85	—
W. Germany	360	—	85	—	30	—	—	—	475	—
Yemen	—	—	375	375	—	—	—	—	375	375
Yugoslavia	530	—	—	—	—	—	—	—	530	—
Zaire	—	—	—	—	205	—	—	—	205	—
Zambia	—	—	—	—	380	—	—	—	380	—
Grand Total	**54465**	**9456**	**19035**	**5293**	**8931**	**1309**	**2138**	**—**	**84559**	**16058**

*Iran data not included.

Number one area in total miles is Europe, with 15,319 miles total of which 1981 miles are under construction. In the number two spot is Canada, with 14,643 miles planned or underway, and 866 actually being built. South America ranks third in total planned or underway mileage with 11,929 miles of which 2177 miles are being built, followed by the Middle East where 7739 miles are planned and underway, with 2307 actually under construction. Africa follows with 7171 miles planned/underway, and is the busiest pipeline area with 2440 miles presently being installed.

Russia has 11,846 miles planned/underway, with 1981 miles reported to be under construction, while members of the Eastern Bloc countries have 1715 miles planned/underway and 535 miles being built. The Peoples Republic of China reportedly is planning 3400 miles of new oil and gas pipelines.

Across southern Italy in Calabria, Saipem crews lower-in a section of the mainland 48-in. gas line; gas will ultimately be transported northward to the Po Valley in northern Italy.

Tough going. Route of dual oil and gas lines in same ditch between Sydney and Newcastle in Australia required moving some big boulders. At right, in easier-to-dig farmland, the two lines have been lowered-in and await backfill.

Europe

Hard hit by continuing price increases for imported oil and a desire to find a replacement for oil, the Continent is placing increased emphasis on developing natural gas supply ... and that means more gas pipelines will be needed. With the demise of gas supplies from Iran to Russia strongly affecting planning of all nations involved, negotiations for new gas supply agreements are underway — especially since many current agreements will expire in 1983. Increased imports from Russia, from Algeria — by pipeline rather than in the form of LNG — and from the North Sea will result in expanded pipeline construction activity.

The negotiations have also revived the SEGAMO plans that would involve a 600-mile line from Algeria to Spain and France and require a crossing (to depths of 6000 ft) of the Mediterranean. The technology for such a line is available. A major question will be the willingness to assume the cost of installing such a line. SEGAMO would eventually require a total system of some 1800 miles of gas pipelines. The pipeline proposal is favored by Algeria, which no longer desires to export its natural gas in the liquefied (LNG) form.

Another "soft" proposal that continues to be discussed is a plan for a 3230-mile, large diameter (48 to 56-in.) gas pipeline originating in the Middle East that would transport now-surplus gas from the Arabian Gulf through Saudi Arabia, Iraq, Turkey, Greece, Yugoslavia and on through and to major north central European countries.

United Kingdom's plans for a major 590-mile gas "gathering" pipeline system in the North Sea would further reinforce the U.K.'s energy-secure position with respect to natural gas and oil. But there are questions about the $2.5 billion project because the current British government is reluctant to provide any major part of the investment, even though the system would add 25% to available gas reserves, and refuses to permit a consortium to have full control. A firm financed by private sector money may be formed to build and operate the line — provided it can come to terms with British Gas Corp., the state-owned monopoly.

British Gas Corp., however, is proceeding with its fourth major gas pipeline from St. Fergus and has underway the 280-mile pipeline running south from the Scottish gas terminal. Other U.K. activity includes a 132-mile, 16-in. natural gas liquids pipeline from St. Fergus to Mossmoran near Edinburgh, for Shell U.K.

In France, work is near completion on the Nozay-Beynes gas line that will transport gas to underground storage at the Beynes site. (*See article this issue on Nozay-Neuville section.*) Work planned in France includes some 500 miles of new gas lines in 1981-1983 by Gaz de France. A 350-mile, 42-in. oil line from LeHavre to the Rhine River is also planned.

West Germany's planned pipeline activity in the next two years includes some 400 miles of new gas pipelines and a 210-mile line from Emden to the Danish border.

Denmark's big new gas transmission and distribution system — totaling some 3220 miles — will get underway in

INTERNATIONAL PIPELINE CONSTRUCTION — BY AREAS

(Underway, Planned, and Proposed — September 1979) In Miles

	Miles of Gas Pipelines		Miles of Crude Oil Pipelines		Miles of Product Pipelines		Miles of Slurry Pipelines		Total Miles	
	Total	Underway	Total	Underway	Total	Underway	Total	Underway	Total	Underway
Europe	13848	1761	687	—	984	220	—	—	15319	1981
Africa	3234	872	1976	670	1961	698	—	—	7171	2440
Middle East	1443	672	4689	1635	1607	—	—	—	7739	2307
Asia, Japan, & Pacific	1937	480	1807	1095	535	—	171	—	4450	1575
Australia-N.Z.	1750	110	3	3	496	101	15	—	2264	214
Canada	9807	720	3738	146	1098	—	—	—	14643	866
Mexico & Central America	2710	1560	946	522	427	51	—	—	4083	2133
South America	8881	1246	1701	692	1205	239	142	—	11929	2177
Subtotal	**43410**	**7421**	**15547**	**4963**	**8313**	**1309**	**328**	—	**67598**	**13693**
USSR	8790	1500	1100	330	506	—	1450	—	11846	1830
Eastern Bloc	1065	535	188	—	112	—	350	—	1715	535
China	1200	—	2200	—	—	—	—	—	3400	—
Subtotal	**11055**	**2035**	**3488**	**330**	**618**	—	**1800**	—	**16961**	**2365**
GRAND TOTAL	**54465**	**9456**	**19035**	**5293**	**8931**	**1309**	**2128**	—	**84559**	**16058**

1981. (*See article this issue on the system's pipeline plans.*)

Spain's Enagas has placed into service its new gas transmission system from Barcelona to the Basque country *(see article this issue)* and plans to build an 84-mile, 24-in. gas line to Zaragoza for $71 million.

Portugal's major pipeline project in the planning stage is a 69-mile products line.

Greece has a 70-mile undersea gas pipeline being planned to bring gas from Italy to Corfu Island.

Norway currently is studying plans to move natural gas from its extensive reserves at Statfjord Field in the North Sea — with the 600+ mile line to continental Europe the principal consideration; alternatives include a 250-mile line to Scotland and a 220-mile line to Norway. The U.K., though, already has a gas surplus, and Norway's principal use for natural gas would be as boiler fuel — an expensive alternative.

Sweden's major pipeline proposal, in the planning stage, is a 186-mile gas line.

Africa

Algeria remains the hotbed of pipeline activity in North Africa with over 3800 miles planned/underway — including three major gas pipelines and three major products pipelines in the design/planning stages; some 1960 miles of lines are currently being laid. Recent completions include major Hassi R'Mel-to-Arzew lines and the Algerian section of the Trans-Mediterranean gas line.

Libya's pipeline activity increased measurably in recent months as Arabian Gulf Exploration let contracts for 380 miles of various size lines to service the Messla oilfield; contract was awarded to Nippon Kokan K.K. and Marubeni Corp.; Zakhem International will build the pipelines.

Tunisia's state-owned electric and gas utility operation, STEG, is planning a new 248-mile gas pipeline system that will provide gas supplies to major Tunisian cities. The Tunisian section of the Trans-Mediterranean gas pipeline has been built ahead of schedule.

Sudan's major oilfield find near Abu Gabra is considered the forerunner of a suggested 800-mile oil pipeline from that point to Khartoum and on to Port Sudan.

In Zaire and Tanzania, major products pipelines continue to be studied. The Zaire proposal involves 200 miles of 20-in. line while the Tanzania project embraces some 678 miles of line from the Zamia border to interior areas.

Middle East

With completion of the east-to-west Petroline 48-in. oil line to Yanbu and the parallel Aramco natural gas liquids line, emphasis on pipeline activity in Saudi Arabia has turned to the major oil and gas/gas liquids gathering systems planned for the eastern oil fields. That includes some 500 miles of crude gathering lines and 900 miles of gas/gas liquids lines.

Abu Dhabi's offshore Zadco system, involving 746 miles of 4 to 48-in. pipelines in the Upper Zakum field, is underway and will be in the works until 1982. Abu Dhabi National Oil Co. (ADNOC) also has 140 miles of line under construction onshore.

In Oman, the 276-mile oil pipeline built by Dodsal GmbH has been completed (*see article this issue*). Planned are another 650 miles, including 140 miles of gas line and 510 miles of oil lines.

Iraq's pipeline ventures include a 684-mile LPG line from Kirkuk to the Mediterranean, scheduled to get underway in late 1980 or early 1981, a 290-mile 20 and 22-in. gas line from Kirkuk to Baghdad, a planned 775-mile, 48-in. oil line from Kirkuk to Tartus on the Mediterranean, and a planned 750-mile gas line to Tartus from North Rumaila.

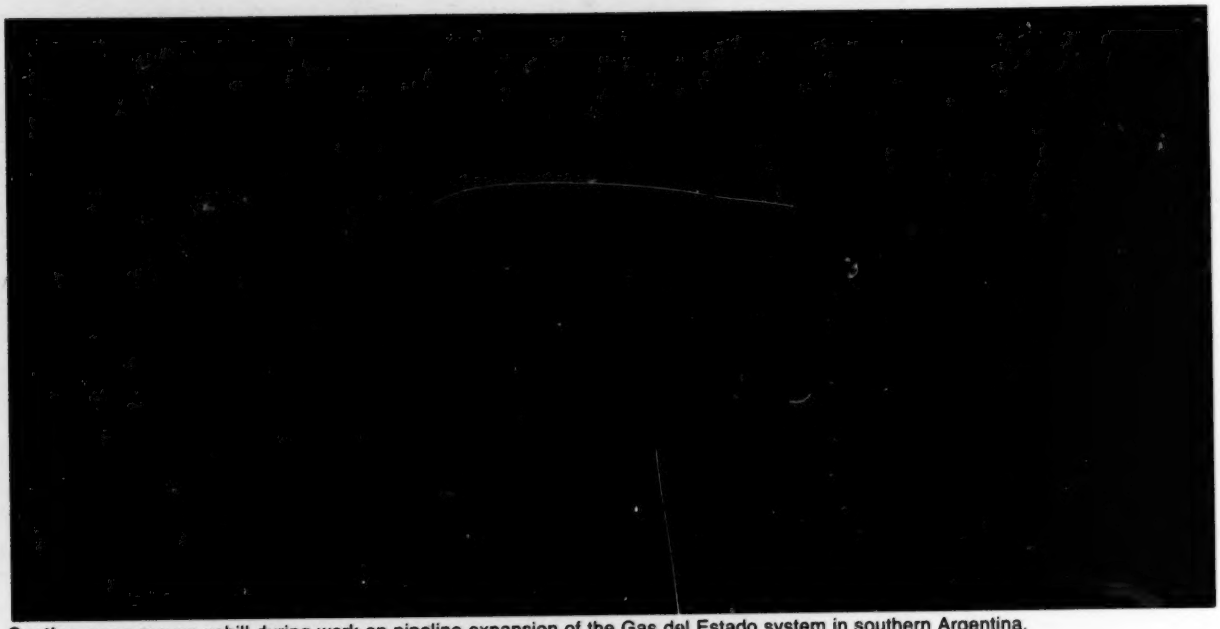
Turkey has ready for building a 270-mile oil pipeline for the Turkish Petroleum Co. between Dortyol and Kirrikyale. Contracts may be awarded in late 1980.

Southeast Asia

Thailand's Petroleum Authority of Thailand (PTT) has underway the 371-mile gas line from offshore platforms in the Gulf of Thailand to near Bangkok. Work on the 266-mile, 34-in. offshore line began near Sattahip with the pulling ashore of the first section of the sealine. Onshore, construction crews began at the landfall and moved north to install the 105-mile, 28-in. landline. The natural gas will supply electric power plants near Bangkok, the capital city.

In Malaysia, engineering is proceeding on the 84-mile, 36-in. offshore gas line that will transport gas from the offshore Luconia gas field to the Bintulu LNG Complex on Sarawak, where a $1-billion LNG facility is being erected. The LNG — 6 million tons per year — will be shipped to Japan.

India has 591 miles of pipelines in the planning stages, and if efforts to find increased oil and gas supplies—onshore and offshore—are successful, will be building a substantial



Coating gang moves uphill during work on pipeline expansion of the Gas del Estado system in southern Argentina.

number of new pipelines in the next two decades.

Pakistan, with 2650 miles of pipelines planned/underway, will complete nearly 1100 miles in the coming months, bolstering the national oil and gas transportation system.

China, anxious to expand its energy supply, reportedly is planning some 1200 miles of gas pipelines to serve industry in areas adjacent to its major gas fields, and 2200 miles of oil pipelines to transport crude from producing areas to consumption areas, where new refineries would be built.

Australia, New Zealand

Pipelining in Australia in the 1980's will be the best ever, industry experts say, if a worsening state of labor relations on pipeline jobs can be solved. Plans for construction of some 2070 miles of pipelines are on the boards; principal projects are an 84-mile, 40-in. offshore gas line from Dampier to the Northwest Shelf gas fields; a 932-mile 24 to 32-in. gas line from Dampier to south of Perth; a 118-mile, 10-in. gas line from Dampier to Pilbara, and a 350-mile, 14-in. gas liquids line from Moomba to Redcliff to supply a proposed petrochemical plant in far South Australia.

New Zealand, with gas flowing from the Maui field, plans to use gas to make methanol and convert that into motor fuel for the nation's trucks and automobiles. Bechtel and Mobil Oil are working out the details; when built, the plant will require more pipelines. Other pipeline plans include a 93-mile products line from Marsden Point refinery to Auckland, and Natural Gas Corp. of New Zealand is studying plans to build 100 miles of 6 thru 16-in. transmission lines to serve new communities with gas.

Mexico, Central America

Mexico's Petroleos Mexicanos (PEMEX) has embarked on a major pipeline program designed to transport natural gas and refined products to all of the major population centers in that nation. Current pipeline plans involve 3889 miles of all types of pipelines, and 2153 miles are under construction, making Mexico the fourth most active pipeline area in the world.

Only other significant pipeline planning activity in the area is that by the Honduras Government to build a 160-mile oil pipeline between the Atlantic and Pacific Oceans across the Honduras Ismuth. The world's current oil surplus has delayed work on the project.

South America

Argentina's Gas del Estado has its Central-West pipeline system under construction (*see article this issue*) with initial work on the 1084-mile system soon to expand as work gets underway on the mainline north from the Neuquen area to Beazley. Another 1417 miles of pipelines are planned throughout Argentina.

Bolivia and Brazil continue to study plans to build a 1900-mile, 24 and 30-in. line to transport gas.

Brazil expects to increase its oil and gas supplies materially with development of the Campos Basin offshore fields where work will begin in December on 340 miles of offshore oil and gas pipelines. Onshore, 309 miles of pipeline will be laid as part of the Campos development.

Colombia's pipeline activity includes 118 miles of 12 to 16-in. line for Ecopetrol, with work to begin in late 1980. Another 500 miles of 20-in. gas line are planned.

Chile's pipeline plans involve some 564 miles of line, including a 112-mile, 30-in. line to supply gas to a proposed LNG facility at Cabo Negro.

Canada

Canada's pipeline fortunes revolve around four major points: one, building of the Alaska Highway Gas Pipeline Project, on which partial approval has been given — some 687 miles of prebuild in 1980 and 1981; two, export of surplus gas to the U.S., which requires considerable new lines, gathering systems, and loops on old lines; three, building of the "eastern" gas system to New Brunswick and Nova Scotia from Montreal, and, four, eventually bringing oil and gas southward from the Arctic regions to markets in southern Canada and the U.S.

Soviet Union

Russia's ministry of oil and gas has announced plans to eventually have seven 1000-mile, 56-in. gas pipelines operating between the Urengoiskoye fields and Chelyabinsk; two of the big lines are in operation and work may be underway on a third — leaving four to go in the next decade or so. Russian pipeliners are also building a 422-mile, 48-in. line from Mozdok to near Baku. Line would help supply gas lost due to the cessation of Iranian gas imports at Astara. Also underway is a 217-mile, 32-in. gas line between Vilinius in Lithuania and Kaliningrad on the Baltic. **P&GJ**

International Report

Denmark's 13,230 Km Gas System

by Hans Jørgen Rasmusen, *Vice President, Engineering and Operations,*

Construction of the first section of gas transmission pipeline in Denmark's ambitious 13,230 km (8220 miles) natural gas transmission and distribution system will get underway in 1981, to be followed in 1982 and 1983 by construction of other major segments and a 230 km offshore pipeline to North Sea production.

Intensive planning and design for the far-reaching system during 1980 follows approval in 1979 by the Parliament of the Natural Gas Plan, result of almost 10 years of preparatory work that began with discovery of gas in the Danish and southern Norwegian North Sea shelf in the late 1960's.

Early attempts to bring natural gas to Denmark were through the state-owned Dansk Olie & Naturgas A/S when Ekofisk gas and later Frigg gas was offered for sale. Plans were made to land the gas in Jutland and route it to the continental market. These plans did not materialize, partly because of insufficient economic incentives.

In the early 1970's, knowledge of indigenous oil and gas reserves increased steadily as result of exploration conducted by Dansk Underground Consortium (DUC), whose partners are A.P. Møller, Shell, Texaco, and Chevron.

DONG was given first right of negotiation for purchase of gas found—and was required to develop plans to market and distribute the gas. More than $10 million was allocated to the various planning activities. The DUC Gas Report was submitted in March, 1978 and negotiations began.

Oil supply problems of 1973-74 and price instabilities of 1978 demonstrated the weakness of a high dependence on imported oil and made it clear that indigenous oil and gas supplies had to be exploited fully.

The Danish Market

The natural gas agreement between DUC and Dansk Olie comprises 55 billion m^3 to be delivered at rate of 2.5 billion m^3 per year, beginning in 1984, with a three-year build up period. Gas will be produced from fields now known as Tyra, Roar, Gorm, and Dan, of which the latter two are associated gas fields. The agreement provides for an increase in the annual production rate should reevaluation of reservoirs indicate recoverable reserves beyond 55 billion m^3. The current government estimate of proven and probable reserves is between 100 and 150 billion m^3.

Table 1 shows the overall primary energy demand as estimated in the energy plan of 1979. The table shows the high overall dependence upon oil as well as the conservation efforts made and planned.

A substantial part of the natural gas will substitute for heating oil in domestic and industrial markets, whereas baseload uses such as power generation will be almost nonexistent. This is because a substantial amount of the power generation uses coal.

Apart from load factor problems created by the high heating content market, build-up poses another substantial task because the current gas consumption amounts to only 5% of the expected plateau-rate.

The market strategy foresees that the first year effort in a particular area will be to connect the large consumers, i.e. industry and district heating, which subsequently may be operated as interruptable customers. The domestic consumers will be picked up during a 4-to-6 year period.

Much effort is currently being put into early market developments. New housing projects which are located in planned natural gas areas are to be temporarily supplied from small LPG facilities. Various measures are taken to avoid large and costly replacements of old domestic oil burners and tank installations, which will have to be replaced or converted to gas a few years hence. Various regulatory requirements are being introduced in order to ease the transition.

A particularly important measure in the market development is an agree-

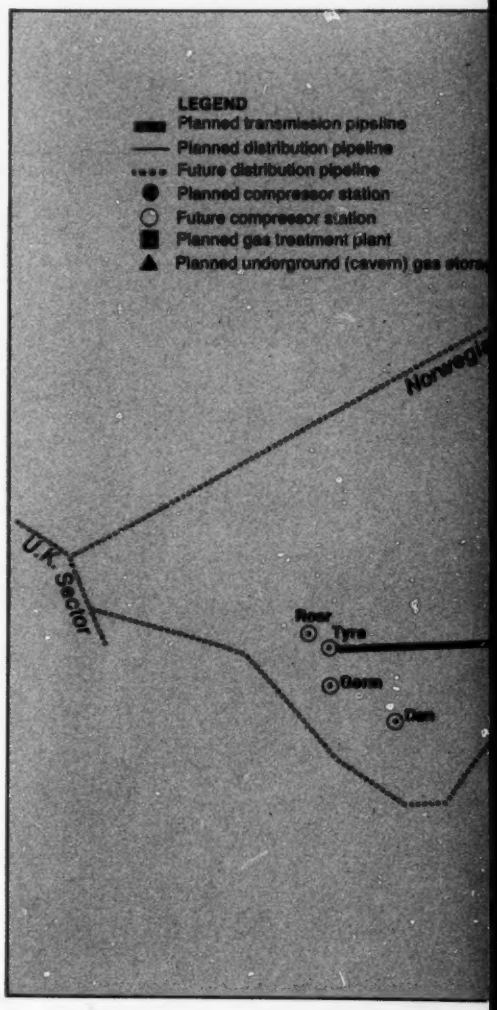


TABLE 1.
Primary Energy Demand in Denmark

10^6 x Gcal	1972	1975	1978	1985	1995
Oil	171	148	151	116	119
Coal	13	21	41	45	51
Wood, sun, waste, etc.	1	2	2	5	10
Imported electricity	2	1	1	—	—
Natural gas	—	—	—	25	40
Uranium	—	—	—	—	30
Total	197	172	195	191	250

TABLE 2.
Principal Energy Use in Denmark
(Natural gas contribution percent shown in brackets.)

Consumption (gross) 10^6 Gcal Total country	Electricity production	Home & office heating	Processing	Transport	Total
1978	58	74	27	36	195
1985	62(3%)	61(26%)	28(25%)	40	191
1995	82(3%)	74(29%)	40(40%)	54	250

To Get Underway In 1981

Dansk Olie & Naturgas A/S, Copenhagen, Denmark

ment signed between Ruhrgas AG and DONG in 1979. The contract with Ruhrgas provides for a possible "soft" start-up of the natural gas supply in 1982-83, with lin[illegible] supplies for 3 years from 3 to 700 million m^3 annually. A "soft" start-up (in South Jutland and Funen) would result in a better distribution of investments and permit a more thorough training of employees.

The Gas Organization

Under the 1979 energy plan, Dansk Olie & Naturgas A/S will purchase and transport gas at high pressure and will sell gas to five regional companies plus a limited number of large consumers.

The regional companies will operate a medium pressure network, normally at about 16 bar (250 psi). They may sell the gas further to municipal distribution companies or distribute directly to the end-users, depending upon local arrangements.

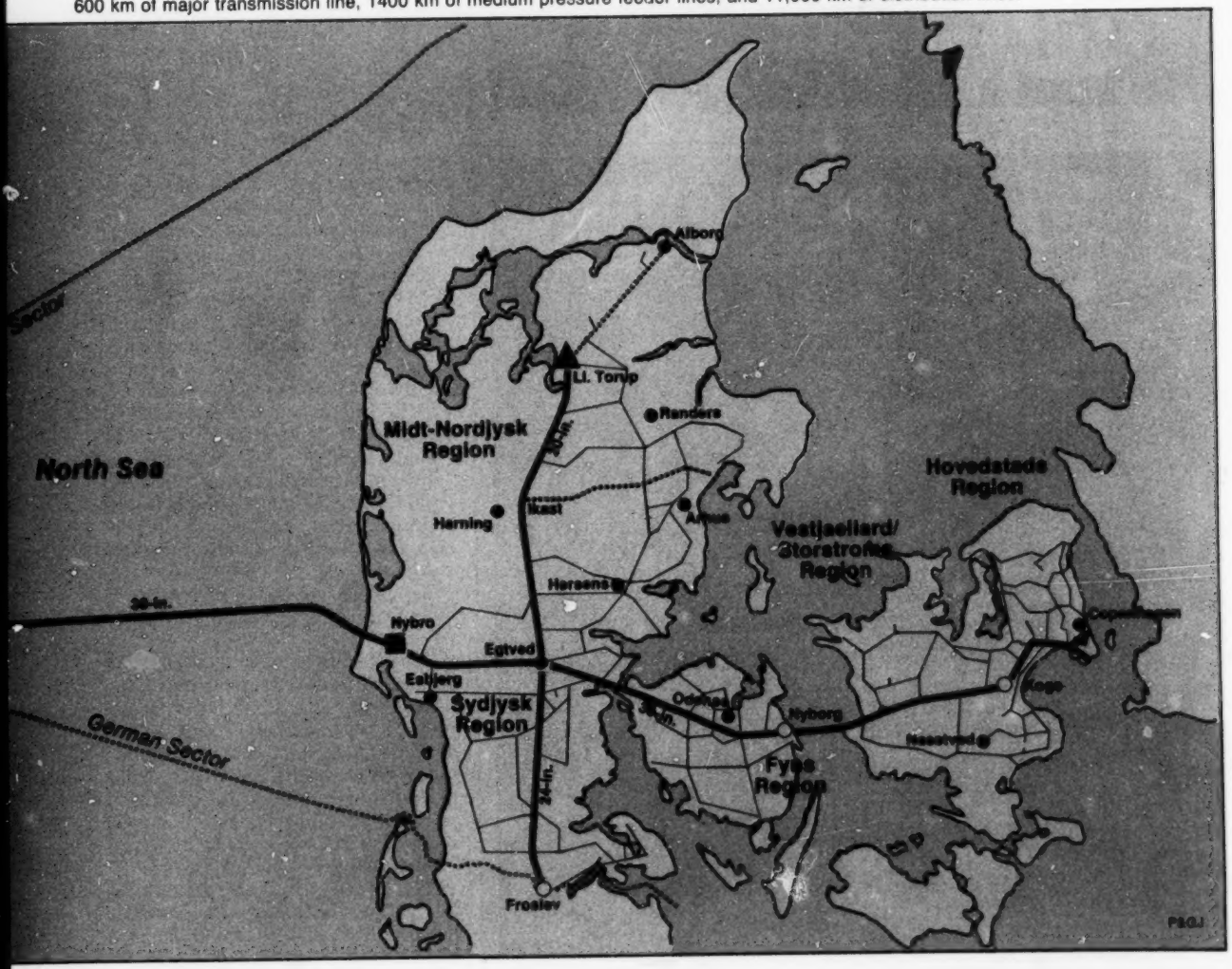
Approximately half of the initial annual gas volume will be sold in the metropolitan area near Copenhagen.

The distribution network in central and northern Jutland may not be developed until additional gas is made available. The main task at all levels will initially be to design and construct the transmission and distribution system. The regional and municipal companies will however also have to engage in sales activities at an early date.

Organizational development not only involves forming companies but also a substantial recruitment and training staff. Beginning with 10 people in 1977, the DONG staff increased to 75 by early 1980, and will total 250 by 1984. A similiar but slightly delayed trend is being experienced at the regional level.

Engineering design and construction will be performed by outside engineering companies and contractors. The engineering design is performed by Naturgasgruppen, a consortium of Danish consulting engineers — Dangroup, Oilconsult, Mogens Balslev, and Dansk Hydraulisk Institute, assisted by Pipeline Engineering (Germany) and Global Engineering A/S.

Extent of new gas transmission and distribution system in Denmark is shown on map—system includes 230 km of North Sea delivery line, 600 km of major transmission line, 1400 km of medium pressure feeder lines, and 11,000 km of distribution lines.



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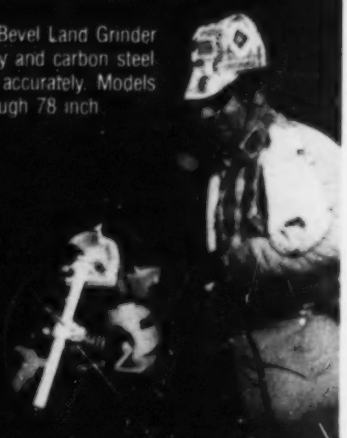

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Every effort is being made to ensure that Danish firms — to the extent that they are competitive as regards price and quality — are able to participate in the design and construction phases.

The planning and construction organization for the transmission system, comprising administration, design, tendering, supervision, and commissioning, etc., will be managed directly or through consultants by DONG.

Technical Design

The virtual absence of existing gas distribution in Denmark permits natural gas to be introduced without design constraints introduced by the problems of conversion of town gas networks.

Three pressure levels will be used:

- 80 bars (1176 psi) for the DONG A/S transmission system.
- 16 bars (235 psi) for the Regional distribution systems.
- 4 bars (59 psi) for the street mains.

The 4 bar street mains distribution system offers several advantages over conventional European low pressure systems. Piping can utilize small diameter polyethylene pipe, normally supplied on reels. Installation can often be made by plowing techniques, particular in suburban areas. PE pipe is not subject to corrosion, which reduces maintenance considerations.

The 4 bar distribution system does require installation of small regulators outside house installations. These regulators will be combined with the meter installation. Total length of the 4 bar system is estimated at 11,000 km (6835 miles), including service lines.

The 16 bar pressure level was selected with specific objectives in mind:

a) This pressure level is below the critical pressure of the dew point curve for the sendout gas. Liquids are not expected to form in this network and facilities for routine pigging can be eliminated.

b) Pressure reduction to the 4 bar level can be accomplished without heating the gas, thus simplifying design and operation of these regulator stations.

Total length of the 16 bar system is estimated at approx. 1400 km (870 miles).

The regional companies may have to accept a limited responsibility for peakshaving of a short duration nature. The most probable means will be by LPG-air mixing stations operated in connection with the 16 to 4 bar pressure reduction. These facilities may also provide a valuable spare gas source in case of short falls in the primary sources.

The DONG A/S transmission system will deliver natural gas from gas fields in the Danish sector of the North Sea to markets throughout Denmark,

with interconnection to the German gas network at the Danish border.

The production platform in the North Sea will be connected by a 230 km, 30-in. offshore pipeline to the west coast of Jutland. Before the North Sea gas can be sold to the consumers, however, it must be treated and small amounts of hydrogen sulphide removed and subjected to various other processes in order to ensure a uniform, high quality. Treatment will take place in a gas treatment plant at Nybro, northwest of Esbjerg.

The natural gas system is sized to accommodate the expected variations in consumption. Maximum consumption is calculated to occur at a mean daily temperature of −14 C. Statistically this, or lower temperatures, will only occur once every 15 years. The heating installations of most consumers are sized for −12 C.

The onshore transmission system will further be sized so that approximately 6 million m^3 per day capacity can be provided for transit of gas on behalf of Swedegas AB of Sweden.

Capacity of the North Sea pipeline will be approximately 25 million m^3 per day based on normal gas composition. This capacity will accommodate abnormal gas compositions, especially during the first years of operation, and provide spare capacity for the transportation of gas from other discoveries.

Capacity of the gas treatment plant is 10 million m^3 per day, corresponding to the maximum daily contrast supply rate; the design arrangement provides for ready extension of facilities to handle approximately twice that volume.

A major part of the fluctuation between summer and winter consumption loads is directly absorbed by changing the supply rate of the natural gas. The gas purchase contract provides for a maximum supply rate of approximately 1.6 times the annual supply rate, based on the average daily consumption at the start of the contract, decreasing over the life of the contract to approximately 1.2 times the annual average supply rate.

Over and above this level, the consumption will be equalized for significant periods by using gas from storage facilities, or by interruptibles.

Storage will be caverns in the salt deposits at Lille Torup in Northern Jutland, and will have an initial working capacity during phase 1 of 110 million m^3, which will be increased to 240 million m^3, and ultimately to 350 million m^3.

During the build-up period it is expected that a number of customer groups, primarily district heating plants, will take gas on the basis of agreements which permit interruption of supply.

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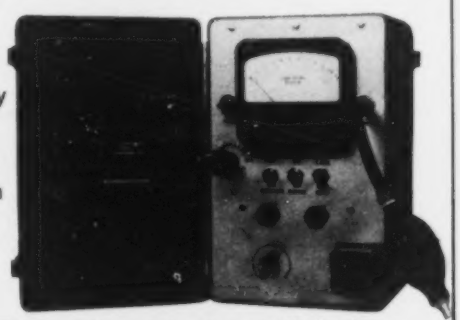

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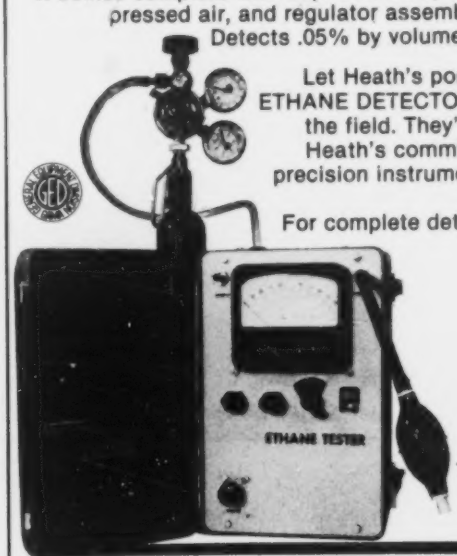

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Time Schedule

Plans to extend the existing gas distribution network in the Copenhagen area have been developed and some construction has commenced. The first LPG satellite units are being constructed during 1980.

Construction of the transmission system will begin in 1981 with the 24-in. Froslev-Egtved pipeline. This pipeline will be ready in the summer 1982, when the connecting DEUDAN pipeline extending from the German-Danish border to the existing German natural gas network will be ready.

The pipeline from Egtved east across Fyn island will be constructed during 1982, including the 1.2 km wide and difficult crossing of Lille Baelt begin in 1983. Construction of the 230 km long North Sea pipeline and the first two H_2S treatment trains at the gas treatment facility will also begin in 1982 to be ready for start-up in the summer of 1984.

The 25 km long crossing of Store Baelt between Fyn and Sjaelland will be constructed in 1983. That year will also see that start of substantial activity of Sjaelland, particularly in the Copenhagen area. Start-up of natural gas supply to Copenhagen is planned for summer 1984, following commissioning of offshore production facilities.

The Future

Even before the first natural gas flows through the new Danish system, plans are being drawn to extend the market and the transmission services.

In February 1980 Swedegas AB signed a transportation agreement with DONG. This agreement provides for transportation of up to 6 million m^3 per day. Gas sources are not yet known, but the capacity will help Sweden in its plans to introduce natural gas. The transportation agreement is supplemented by a gas sales agreement through which DONG will make approximately 200 million m^3 of gas available for Swedegas AB.

The full extent of the indigenous Danish resources are not known, but it is likely that 1 to 2 billion m^3 of additional gas will be handled by the system in the late 1980's.

The excess capacity of the Danish North Sea pipeline provides a suitable means to land gas from smaller reserves in the vicinity of the Danish fields or to be part of a system for transport of North Sea gas to the European markets. While all of the above prospects are still in the development stage, they do however serve to indicate the longterm developments to which the Danish natural gas system may contribute.

P&GJ